A Report for
the Centre for Cross Border Studies

The Evolution of Telecom Technologies: Current Trends and Near-Future Implications

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February 2001

THE EVOLUTION OF TELECOM TECHNOLOGIES: CURRENT TRENDS AND NEAR-FUTURE IMPLICATIONS

A project commissioned by
The Centre for Cross Border Studies
with funding from *eircom*

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Executive Summary

Summary of the Conclusions to the Sections of this Report

Our initial workplan was ambitious - to chart out relative developments on both sides of the Irish border in areas relating to telecoms and information technology. In practice it was clearly to be limited to a selected number of detailed case-studies. There is no alternative to such an approach given the continuing fast pace of technology change. To this we can add also the many progressive economic and attendant political and social changes currently taking place on the island of Ireland. Faced with such dynamism, part of the problem we had to address was just which case-studies were most particularly deserving of our attention? Could we specify case-studies such that our resulting recommendations and conclusions would be motivational and inspiring, not just at the time of finalization of this report, but in the months ahead?

Our selection of case-studies was biased towards mobile and wireless telephony, given that this is a leading, and driving, area of technology. Market uptake is large, purchasing of 3G licences was a topical issue during the time-period of our work, and indeed some very major company mergers took place during these few months (March 2000-February 2001). What was of interest to us far more was the technological future made possible by this evolution. We may not have high quality video coverage from kindergartens or for care of the elderly on our mobile phones in the very near future but the advertising of telecom operators certainly has told us often enough that we will! So in part we wanted to coolly and calmly appraise near future up-and-coming technologies. Having sectors such as education and healthcare in mind, we wanted to focus on inexpensive and easily used solutions.

However quite basic issues - at first sight policy- rather than technology-oriented - loomed large. Prime among these was the issue of what one pays for mobile phone services. This area is a near impenetrable jungle. The border in Ireland makes it worse, if only because there are many additional operators. If we can bring order to informational chaos in this area, then this surely is a contribution to cross-border economic development. Our contribution may well be applicable to other cross-border regions elsewhere. If so, we are smiling. Our starting point for data collection, and the means proposed herein for extraction of solid, usable information from this data, is the Irish day-to-day reality, in the Republic, in Northern Ireland, and roaming from either side to the other. Our online system for making mobile phone tariffs transparent - glasnost for cellphones - is a service which we hope to continue to provide.

We pinpointed another lack in economic development: the potential for new services such as provision of cross-border VOIP (Voice Over IP) or voice over computer data connections. We stress the free, stable and reliable aspects of computer-based “collaborative work” environments, possibly supporting video linkups.

Executive Summary

In telecare, we selected an area of innovative practice in Northern Ireland, which has actually been exported to the Cork area in recent months. From this, we quantified the very significant cost savings which are possible by generalizing this work to other parts of the Republic. This leading example of what should exist more widely in Irish healthcare - in both parts of Ireland - truly has potential gains for everyone: for the paymaster-state, for the suffering patient waiting in line, for hospital administrators, and even for our road and rail transport systems. It is a telling example of a cross-border linkage leading to substantially more than the sum of the individual parts.

In education, we looked at technical infrastructure in the classroom, in the context of cross-border school collaborations. We wanted to see just what sort of maintenance and overseeing was needed. Mutual understanding of culture was a targeted and achieved goal. So also, in such work, is a healthy understanding and appreciation of technology and technological options. More generally in videoconferencing, while it is recognized that this is a technology of the future, we have some right to ask why is it not happening in a wider and broader way right now? The cost and ease of use of the equipment and the tools needed are not at all prohibitive. Part of our last section in this report can be taken as a helpful "hands on" guide to what can be relatively easily set up and maintained. If you, the reader, cannot do so, then it is certain that your teenage - or younger - son or daughter will.

Policy recommendations were foremost in our minds in our investigation and appraisal work. However the age of telecoms - and the age of information technology à la Unix, the Web, Napster, and so on - sees us, ourselves, as being prime movers in focusing and channelling policy and practical procedures. If one may be bold enough to say so, the market place much more than government in this day and age determines policy. In addition to the market place we also wish to point to bottom-up technological development and creation of procedures and practice that guide and govern our daily life. Microsoft, whose "policies" we very often have no choice but to follow and use, did not grow by government decision but instead by fortuitous but commercially-savvy growth in a number of hugely bountiful riverains of the modern economy.

RECOMMENDATIONS

Pricing and Tariffs

1. An online and 24/7 accessible mobile carrier tariff information system for both parts of Ireland should continue to be supported and upgraded. It should become a primary point of reference, and should later be expanded internationally - for those using roaming in Ireland, North or South, for Irish roamers abroad, and more generally as a service for all whose daily activities bring them - anywhere - across state borders.

2. It is recognized that such an online mobile service provider tariff system requires close cooperation with the service providers. The consumer will benefit from transparency of information.

Healthcare Applications

3. Telecardiology and related distributed healthcare technologies should be used more widely to bring clearly demonstrated benefits to the patient, the hospital, the state, and society generally.

Education Applications

4. Cross-border collaborative school link-ups have benefits for cultural understanding, and for an awareness of the communication technologies of the future. The economic development implications should be noted.

5. The training of personnel to help push forward new technology usage and understanding is needed.

6. A clear place in the curriculum for telecoms and other IT-related technologies would be a powerful further inducement to the technological, cultural, and economic development benefits noted.

Technology

7. Technologies for new practices of collaborative work, and for dissemination of digital video and audio “experience”, are available right now inexpensively and without undue hurdles to access and use. Their take-up is waiting to happen.

8. The mobile and wireless infrastructure does not yet cater for demanding applications based on, e.g. video. The telecom operators should be encouraged to bring in new services, based on GPRS and G3, fast.

9. The vast sums paid for G3 licences cannot be passed on to the end-consumer. High consumer prices for near future mobile and wireless communication technologies would only crush the great potential of this technology at birth.

10. Public authorities, including local government, medical and educational bodies, can play a leading and motivational role by using new technologies, for example by video- and audio-broadcasting on the Web.

Background and Scope

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This project ran from March 2000 until February 2001. It was led by **Professor Fionn Murtagh**, Computer Science, Queen's University Belfast, and **Dr. John Keating**, Computer Science, National University of Ireland Maynooth.

Introduction

New uses of the web and of the Internet will doubtlessly play an increasingly important role (i) in society and (ii) in business. Are the two Irelands growing closer against this backdrop, or are different poles of attraction emerging? For business reasons, both the Republic of Ireland and Northern Ireland have a lot to gain by keeping new telecom technologies in lock-step. Given the myriad personal and community cross-border linkages, this is a key area of technology for various areas of cross-border related policy: in health, in care for the elderly, in education, and in social inclusion generally. The researchers represent leading research teams in Belfast and the Dublin region in the key areas of technology which are of relevance. A range of practical tests and assessments will be carried out by the researchers. In addition, an investigation will be made of relevant activities, and planned projects will be carried out oriented towards community groups, professional associations, educational and health authorities. This is likely to be of very considerable value for informing policy in local government and community relations, in health, in education, in "third age" work, and in other domains. A third *volet* is to host a public presentation of results and conclusions in Dublin and/or Belfast.

Mobile telephony is a market sector where Europe leads the US and Japan in certain aspects. It has been estimated that by 2004 one in three Europeans, or 219 million people, will be accessing the Internet through their mobile phone (Forrestor Research). Irish employers and Irish consumers are playing their role in these developments. Major industrial groups in the Republic include *eircom* and Ericsson. Web-based delivery of financial information to mobile phones was introduced by stockbrokers NCB on 12 October 1999. In Northern Ireland industrial champions include BT and Nortel, and mobile telecom providers Vodafone, Orange and so on. Belfast company APiON was partially sold to Phone.com in mid 1999, the latter being a world leader in Web-based information dissemination to mobile phones and related portable display devices. If Ireland does not quite match the level of market penetration of Finland, it is nonetheless clearly in the front-line, in regard to research, R&D, product and service development, consumer use, market growth, and market penetration. As this study was being carried out, in the Republic Esat was purchased by BT, and *eircom* was seeking partners. In Northern Ireland Vodafone pursued its ambitions vis-à-vis Mannesman, a tussle instigated in some measure by

the latter's purchase of Orange. The implications of such sector readjustments, while difficult to predict in detail, are unquestionably very significant. It is clear that tectonic movements are taking place on both sides of the border, often with little relationship to developments in the other jurisdiction.

Our concerns in this project are related to the policy issues arising from the evolution and development of communication systems within and between the Republic and Northern Ireland, both for governmental authorities and for a range of non-governmental organisations.

The Republic and Northern Ireland are following the market drives and ambitions of different industrial groups. The potential for introduction of new services at different times, or for the evolution of pricing and service strategies at different time-scales, follows immediately. Consider for example the developments related to Web-based provision on mobile telephones noted above. Fundamental here is the use of the WAP protocol (Wireless Applications Protocol) and WML (Wireless Markup Language, an enhanced and specialized version of HMTL). Will WAP-based services be introduced on different time-scales? Consider as a second example the introduction of picturephones or videophones. About a year ago, these were introduced on the Japanese market by NTT DoCoMo. Orange has announced the near-future introduction of a videophone. If this happens, Northern Ireland consumers will be served sooner with this technology. If personal and cheap consumer videophone technology takes off (the indications from Japan are positive) then there could be "time zones" of technological development and evolution introduced between Northern Ireland and the Republic of Ireland.

Pricing presents an even more immediate issue. In the highly opaque area of pricing strategy, driven at least in some measure by data mining in consumer and usage data, how are services and products priced in the Republic and in N.Ireland? Are there major divergences? Can corporate policy be divined from current pricing strategies and policies? Most of all, what are cross-border pricing levels? From the old days of the state monopolies, it is the case that calling Northern Ireland from the Republic (and from nowhere else) necessitates the use of local area code 048 (changed from 08 in the course of 2000), whereas calling the Republic from Northern Ireland requires use of international dialling code 00 353. The online service provider Compuserve has one local-rate number for access anywhere in the UK, including Northern Ireland, whereas Irish consumers outside of Dublin, Cork and Shannon must face appreciably higher non-local access rates. Is any particular favour shown to immediate cross-border areas, such as between immediate cross-border regions on the European mainland, where special dialling codes and corresponding pricing applies? The answer is 'no'.

Internet delivery through TV set-top boxes presents another area of mismatch between technology development in N. Ireland and in the Republic. Cable company NTL promised availability in Belfast and elsewhere in Northern Ireland

of their set-top boxes in the summer of last year, but this has still not been realized. (We understand that the reasons for this are managerial and organisational, rather than technical.) What are the services offered currently and planned by the major cable operators? For urban areas, cable delivery of Internet is a viable proposition. For less urban areas, satellite delivery may be more feasible. The Astra satellite, whose footprint well covers the island of Ireland, has had availability of Internet for some time, although it appears that this is only marketed towards commercial clients. How feasible is delivery of Internet in this way for small urban and rural communities in Donegal, for instance?

Major linkages imply favoured status for bandwidth, with knock-on effects for inward investment and employment generation. Nortel Networks in Northern Ireland provide very high bandwidth fibre-optic connections for the Web, but also potentially for telemedicine and other applications. Dedicated network links are available between Dublin and Belfast for supercomputing applications and development work. In the case of all such linkages, we need to have a clear map of available capacity, and to know what future policy is in regard to maintenance and access. The academic Internet link from Northern Ireland goes from Belfast to Manchester, but has been quite unreliable at times in the past. How do Irish backbone linkages perform overall, and what are the implications for access by consumers and SMEs, and for general industrial development, of current and planned topologies and architectures? How, in particular, do the immediate cross-border areas fare in this context? These areas are among the poorest, with rural poverty being equally reprehensible as urban poverty. Donegal has had to face closures of textile production units in recent times. These areas cannot be allowed to miss out on the telecoms evolution, and their current status needs to be charted and clearly assessed.

The international railway system in Europe was hindered by differing standards (e.g. the gauge used in Spain compared to France), and such communications restraints were not infrequently motivated by military or related strategy considerations. We do not wish to have the telecoms infrastructures of Northern Ireland and the Republic of Ireland running on different gauges. A valuable first step will be quantitative and qualitative assessment.

Market Indicators and Market Assessment

(Source: Nua Internet Surveys, http://www.nua.ie)

December 2, 1999: "78,000 homes representing 13 percent of the population have access to the Internet in Northern Ireland, according to Quest Research & Consulting.

The figure represents some 216,000 people and in some urban areas penetration is as high as 16 percent. Quest analysts predict that up to 20 percent of households in Northern Ireland will have Internet this time next year.

These findings rank Northern Ireland alongside Ireland, France and Germany and ahead of Italy and Spain in terms of Internet penetration. The UK figure is higher at over 20 percent while Scandinavian countries continue to lead the field with penetration in Sweden estimated at 40 percent."

June 21, 2000: "Only 8 percent of the 127,900 businesses surveyed in the Republic of Ireland have an email address and only 4.3 percent have a website. In Northern Ireland, those figures drop to 5 percent and 3.7 percent respectively.

Companies with less than 10 employees account for almost 88 percent of all Irish businesses but only 2 percent have Internet access. Almost 49 percent of Irish businesses with more than 50 people have email and 34 percent have a website. In Northern Ireland, 3 percent of large businesses have email and 25 percent have a website.

Previous surveys indicated that Internet penetration in the business sector was as high as 70 percent but the samples in these surveys were far smaller."

August 23, 1999: "A new study from Datamonitor finds that while 50 percent of people have access to a PC in the south eastern regions of the UK, less than 35 percent have access in Lancashire, the Midlands and Northern Ireland.

A quarter of all Londoners are online at home compared to just 13 percent in Northern England. On average 18 percent of UK adults are online at home. In the south east, 50 percent of people have household PCs while less than 35 percent of homes in Northern Ireland have PCs.

3 million people are online in London and the region is a prime target for growth in the near future. The Midlands, the north of England and Northern Ireland are the laggards."

3

An On-Line Tarriffication System, www.B4UCall.com

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Preamble

Mobile phone tariffs are bewildering. Even in a single jurisdiction, the range of choices is quite unfathomable. First, to purchase a phone with a contract - not pay-as-you-go, which in some cases would preclude roaming - many innocent buyers in Northern Ireland (particularly those from another jurisdiction) are faced with a three year residency requirement in the UK. Similarly, there is often a one year residency requirement in the Republic of Ireland. Then he or she finds a non-itemized bill each month, unless a small additional sum is paid. This done, inconsistent labelling is applied to records of calls made, and time and effort are needed to unravel what and where are the free minutes, and whether one is in peak or non-peak time. Let us carry out a thought experiment at this point and imagine the consumer trying to do all of this for the services of different vendors. It truly is an impossible task.

The following report describes an online system to answer this need. It concentrates on mobile telephone charges in and between Northern Ireland and the Republic of Ireland. A graphical display is provided from information which is obtained in real time from stored repositories of tariffs. The system depends on the data available, which has been been obtained (often with much foot-slogging difficulty) from the telecom service providers.

The system described here cannot be simply characterized as being as good as the data available to us. In fact, it is far better because it is a first ever attempt to allow the consumer to make sense of the scarcely penetrable jungle of tariff and pricing information provided by the service providers.

Summary

This paper describes B4Ucall.com, an interactive information server that provides online mobile phone tariffication information for Northern Ireland and the Republic of Ireland. Using the system it is also possible to compare packages offered by different service providers, and to determine cross-border and roaming call costs. Information is provided using easy-to-read charts that are dynamically generated from custom-designed models of the service provider tariff structure data.

An On-Line Tarriffication System, www.B4UCall.com

1. Background

Recent studies indicate that mobile penetration is just below 50% in both the Republic of Ireland [1] and Northern Ireland [2]. Purchasing a mobile phone package is becoming an increasingly bewildering task, however, as the selection of packages available is constantly changing. Furthermore, identifying the most suitable package to subscribe to is difficult, as the packages from different service providers are not usually directly comparable. Packages are usually presented with highly structured tariff information where the price of a call is dependent on several factors including call duration, the time the call is made, and call destination. This inability to make direct comparisons is further compounded by dissimilarities between packages: for example, the time of day that is considered "peak" may differ between service providers, or between packages offered by a single service provider. The allocation of inclusive minutes on offer also differs significantly: some packages offer off-peak inclusive minutes, some offer all-day inclusive minutes while some offer a monetary value for inclusive minutes. A number of packages offer unique features such as bulk volume discounts, whereby making calls above a certain number of minutes results in cheaper calling rates. Furthermore, certain types of tariff information are hard to determine from the published materials. It is a particularly arduous task to establish the costs incurred and pricing structures associated with international roaming (using a mobile telephone abroad, or in our case across the Irish border), as the charges for the service provider and the roaming partner are required.

It is very easy to accept the default roaming-partner selected automatically by the mobile handset, and subsequently make a telephone call without giving consideration to the potential difference in cost for that call had the best (cheapest) roaming-partner been chosen. We have established (see *Section 4: An Analysis of Mobile Phone Calling Costs in Northern Ireland and the Republic of Ireland)* that there are significant savings to be made by choosing the best (cheapest) roaming partner. These savings may be substantial for regular cross-border travellers, or for people living in border areas who have access to all five networks (Eircell, Esat Digifone, BTCellnet, Orange and Vodafone). For example, companies that operate in both Northern Ireland and the Republic of Ireland and provide mobile phones for use in both states, should, we believe, purchase a Northern Ireland package to avail of overall cheaper calls.

To assist consumers and help them to make a more thorough and knowledgeable decision, the research team has developed an online information system that allows the comparison of packages offered by different service providers. Using this system it is also possible to determine cross-border and roaming call costs, and identify suitable roaming partners. Information is provided using easy-to-read charts that are dynamically generated from custom-designed models of the service provider tariff structure data.

2. Creating the Information System

One of the most important phases in the development of any information system is the collection of the data it encapsulates. Initially, it might seem that this is a relatively straightforward task, as there are only five mobile telecommunication services providers considered in this study: two in the Republic of Ireland (Eircell and Esat Digifone) and three in Northern Ireland (BTCellnet, Orange and Vodafone). This was not the case, however, as the data was obtained from a variety of published sources - for example, company brochures, company websites [3], sales outlets, and via the free help lines (both email and telephone) provided by all operators. In the case of the latter, it was not always possible to obtain information unless one already had an account with the service provider under consideration. In general, it was found that the providers were willing to provide tariff details, if available, but detailed information on roaming charges was only sometimes available.

A notable feature of the information-gathering phase was the constant state of change in the tariff structure of the various operators. This meant that in addition to the acquisition of new data, constant monitoring of price and tariff structure changes was required. Each service provider offers both monthly and prepay packages with specific package-associated tariff structures, and often has a selection of roaming and international tariff structures. It was evident that the proposed information server would require a level of sophistication capable of handling significantly different tariff structures that were subject to constant, and perhaps radical, change. Another significant feature of the service provider information collected was the variety of data-presentation formats. These ranged from bar charts on service provider pamphlets to spoken tariff quotations obtained from telephone conversations. The proposed information system, it was decided, would provide all information in a consistent visual format that would be common to all service providers. Finally, given the cross-border nature of the project, it would be essential that the system provide information not readily available from local service providers, and in particular, provide detailed estimates for roaming and international calls between Northern Ireland and the Republic of Ireland.

We believed that a publicly accessible, interactive website fulfilled the requirements for an interactive visual format that allowed both presentation and comparison of tariffs and was the best way of publishing the results of our investigation into tariff structures in Northern Ireland and the Republic of Ireland. A more formal report giving a sample analysis and synopsis of cross-border roaming tariffs, together with some policy recommendations related to pricing and provision of consumer information, is given elsewhere in this document. Given that tariff data is subject to constant change, we opted for a dynamic, database-driven website that would present costs for three fixed-duration calls for a variety of packages at the time of access, based on the most-recently

available data. A tariff-calculator is provided for visitors who wish to calculate the cost of specific call types at other times. It was planned that a future enhancement of the system would facilitate user customisation, including specific package selection and cost calculations by default.

Once the data was collected, a tariff model of each individual service provider's data was built. A significant feature of the tariff models is that they are dynamic, and are sufficiently flexible to adapt to changes in tariff structure with minimal re-structuring. Each model provides a consistent interface, and allows custom-designed query software (Tariffication Software) to interact with all models simultaneously. Access to each model is network-based, thus allowing each model to execute on a different machine anywhere on the Internet independently of other models. Additional models may be added with relative ease, and at the time of writing a model is being developed for a third (Republic of Ireland) service provider, Meteor, which has been granted a mobile licence and is due to launch on 22 February 2001. For the initial website, the Tariffication Software automatically uploads the tariff tables to the website, and online charting software uses these tables to dynamically generate the visual representations. It is hoped that later versions of the software will generate the visual representations directly. We opted to present the data in bar chart format, showing the cost along the ordinal axis for each of the call durations specified. We show the costs for a single operator package on a separate chart for clarity, and each chart has associated labels giving the operator and package names. As the charts may be stacked vertically, and have comparative ordinal scales, it is easy to compare costs for several packages or operators by comparing the length of the bars shown. Each chart also shows associated costs in pence to further aid comparisons. A sample screenshot of the website (www.b4ucall.com) homepage is shown in Figure 1.

An On-Line Tarriffication System, www.B4UCall.com

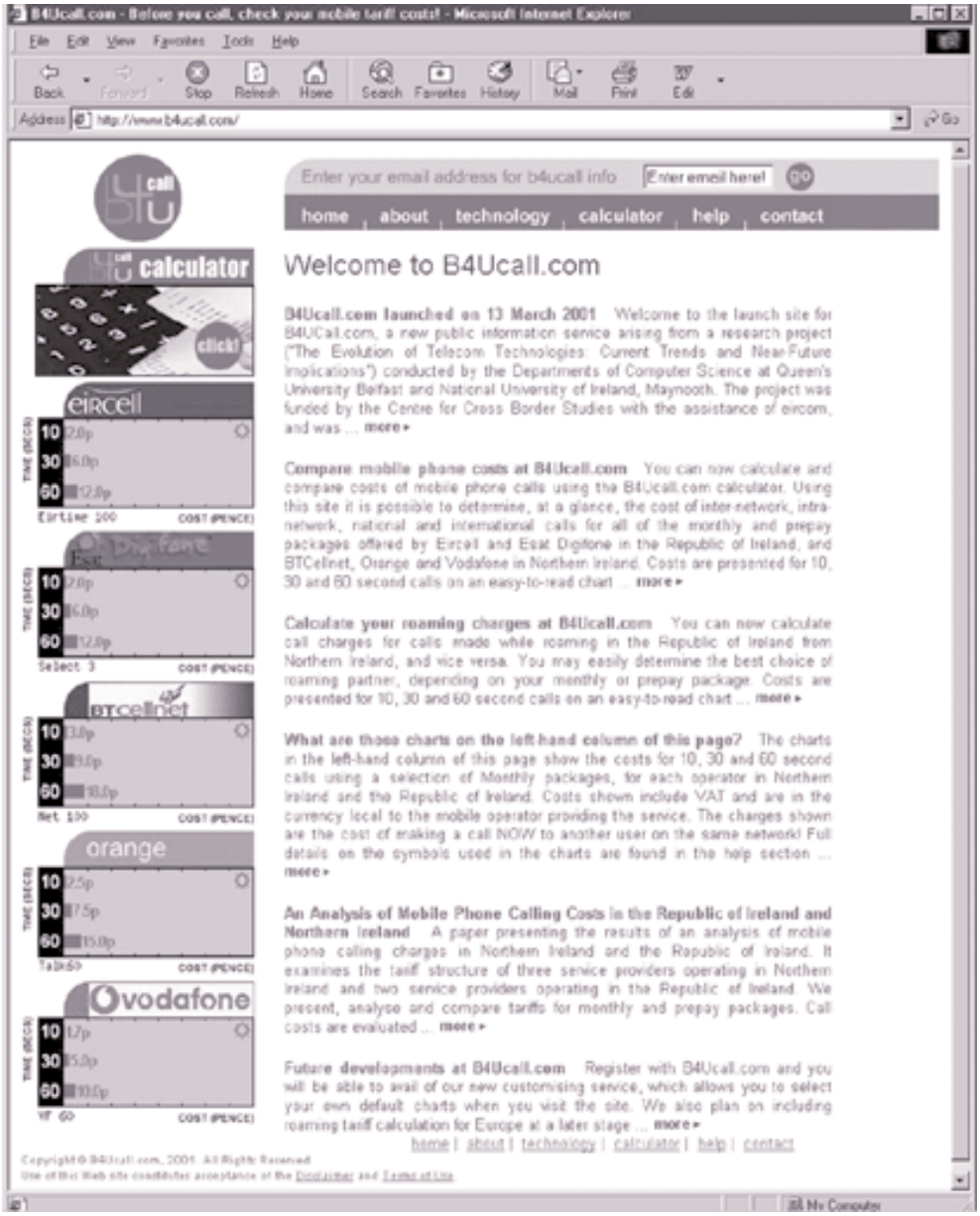

Figure 1. Screenshot of website (B4Ucall.com)

3. Tariffication Services

The online system B4Ucall.com (located at http://www.b4ucall.com/) is an interactive informative guide to mobile tariffication in the Republic of Ireland and Northern Ireland. It provides the calling cost of calls made in the Republic of Ireland and Northern Ireland to (i) a fixed national line within the same state; (ii) a number within the same mobile network; (iii) a number on a different mobile network but within the same state. Additionally, it provides the cost of calling cross-border numbers (calling Northern Ireland from the Republic of Ireland, and vice versa) and the cost of cross border roaming calls.

Calls within the same state

As stated previously, tariffs are not only dependent on the duration of a call but also on the network used and the time of day when the call is made. B4Ucall.com uses charts to depict this information in a manner that is easy to read and understand. The charts detail the cost of a 10-, 30- and 60-second call to either (i) a fixed-line network, (ii) the same mobile network, (iii) another mobile network, or (iv) a cross border network at a specific time of day. The ordinal axis shows the cost of the call in the local currency of the mobile operator providing the service and includes VAT. To indicate whether the call is made at peak time, off-peak time or at the weekend three icons are used. A “sun” is used to indicate a peak call, a “half-moon” indicates an off-peak call, and a “smiling face” indicates that a weekend tariff applies. If an icon is not present, the costs shown apply at all times and are not subject to peak, off-peak or weekend rates. It should also be noted that not all operators operate all three rates. Three examples of the dynamically generated chart format used by the system, displaying the costs of making a call on “Eirtime 100” to another Eircell number at each of these three times are shown in Figures 2(a), 2(b) and 2(c), respectively. Figures 3(a) and 3(b) demonstrates how B4Ucall.com allows easy visual comparison of similar packages from different service providers, thus identifying the package offering the cheapest calling costs at that time.

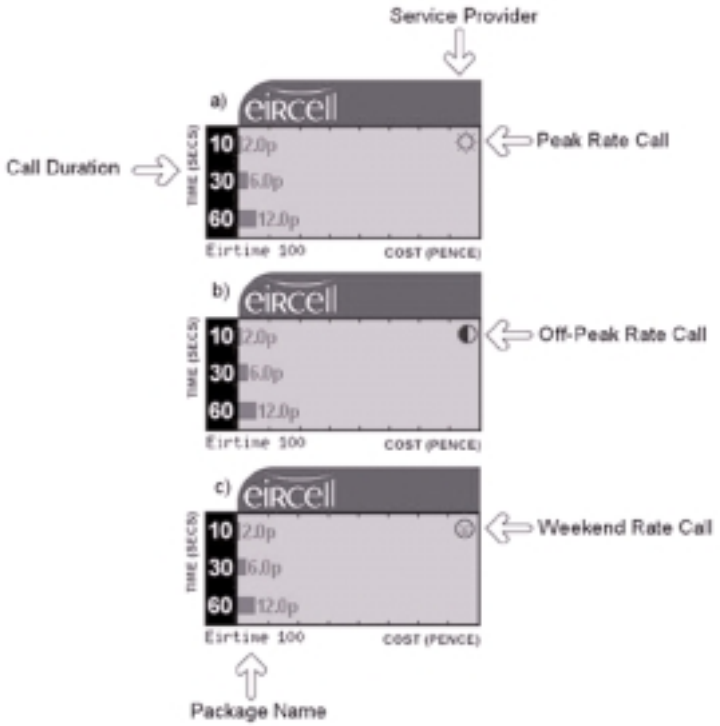

Figure 2: (a) costs for 10, 30 and 60 second calls made at Peak Time with Eirtime 100 (same network), **(b)** costs for 10, 30 and 60 second calls made at Off-Peak Time with Eirtime 100 (same network), and **(c)** costs for 10, 30 and 60 second calls made at Weekend Time with Eirtime 100 (same network).

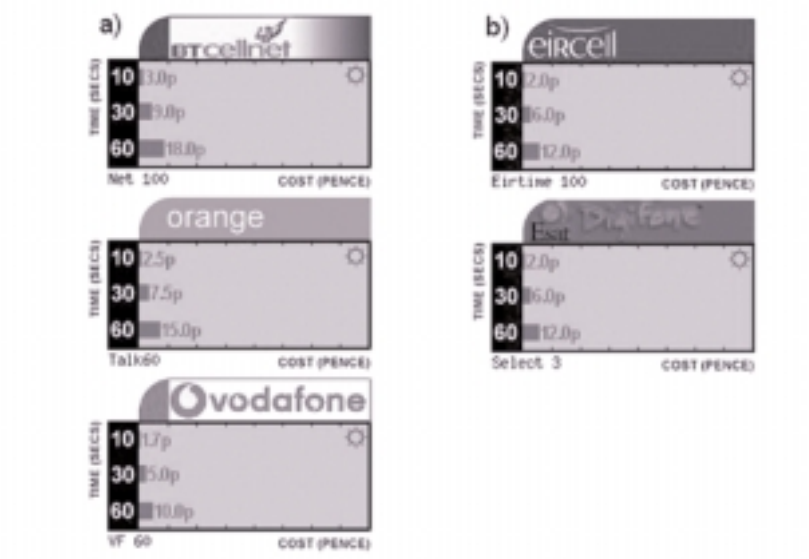

Figure 3: (a) a comparison of Net 100, Talk 60 and VF60 (at peak time, same network), and **(b)** a comparison of Eirtime 100 and Select 3 (at peak time, same network)

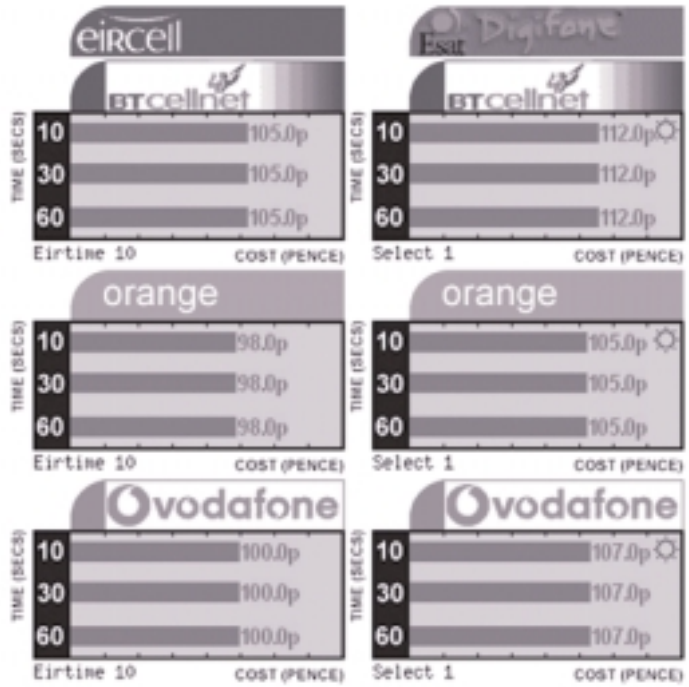

Figure 4: The cost of "calling home" (to the Republic of Ireland) while roaming in Northern Ireland.

Figure 5: The cost of "calling home" (to Northern Ireland) while roaming in the Republic of Ireland.

Calls while Roaming Cross-Border

B4Ucall.com also provides immediately accessible and up-to-date information on roaming costs. Roaming costs are divided into (i) the cost of calling home while abroad; (ii) the cost of making a national (same country) call while abroad, and

(iii) the cost of receiving a call while abroad. These costs are presented using the format described previously. Sample costs for 10, 30 and 60 second roaming calls are shown in Figures 4 and 5 for roaming in Northern Ireland and the Republic of Ireland, respectively. The charts shown are for specific packages and are the cost of "calling home". However what constitutes "calling home" is not clearly or adequately defined by the telecom operators.

4. Future Developments

B4Ucall.com is a comprehensive and interactive guide to the cost of making mobile telephone calls. It currently provides calling costs, in chart format, for fixed-line, inter-network, intra-network, international and roaming cross-border calls for all of the service providers in Northern Ireland and the Republic of Ireland. The home page currently provides inter-network call costs for a collection of similar packages, one for each service provider (as shown in Figure 1). We are aware, however, that as personal users typically subscribe to one service provider, they may be more interested in viewing several charts for a specific package, or collection of packages from that service provider. We propose to provide a registration and customisation facility, where users may specify the packages they would like present on the home page - for example, it would be possible to have five different cost charts for a single package, rather than a selection from each service provider.

We propose to provide potential mobile-phone users with online-assistance when choosing a package. By answering simple questions on proposed usage, we will provide comprehensive costings for appropriately matching packages, selected from all relevant service providers. Using the charts, the user will be able to compare prices in an environment conducive to comparison and examination, rather than the pressured environment typically associated with high street stores.

The tariff calculator currently provides costings for monthly packages, and for calls of fixed duration. This is a subset of the model data, however, and it is a straightforward task to extend the calculator to include prepaid products and calls of variable length. The Information System can also encapsulate other data including monthly rental charges, connection charges, inclusive minutes, SMS (Short Message Service) costs, WAP (Wireless Application Protocol) costs, and unique features specific to particular products. These data may also be provided online at a later stage, and would certainly augment the tariff information provided in the proposed online-assistance module.

References

[1] "More Competition evident in the Telecoms market", ODTR, http://www.odtr.ie/docs/pres280900.doc, September 2000

[2] "Consumers' use of mobile telephony" Oftel, http://www.oftel.gov.uk/cmu/research/ August 2000.

[3] http://www.eircell.ie/
http://www.digifone.com/
http://www.orange.co.uk/
http://www.btcellnet.net/
http://www.vodafone.co.uk/
Service Provider brochures.

4 An Analysis of Mobile Phone Calling Costs in Northern Ireland and the Republic of Ireland

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Preamble

The telecoms which play a major role in the Republic of Ireland and in Northern Ireland are different. There are knock-on effects on what one pays for services. It is known that in cross-border areas, the default service provider may well be across the state line, which has significant implications for what one pays: one finds oneself roaming in one's own back garden. More generally, understanding the costs involved in voice, data or other uses of mobile telephones is an extremely difficult task. The following report is a contribution towards the badly needed comparative appraisal of mobile telephone costs. Such a comparative appraisal has never been carried out before at this level of detail, to our knowledge.

Summary

This section presents the results of an analysis of mobile phone calling charges in Northern Ireland and the Republic of Ireland. It examines the tariff structure of three service providers operating in Northern Ireland and two service providers operating in the Republic of Ireland. We present, analyse and compare tariffs for monthly and prepay packages. Call costs are evaluated based on the type of network called. This includes calls to (i) a fixed-line network; (ii) the same mobile network; (iii) another mobile network, and (iv) a cross-border (international) network. Cross-border roaming call tariffs are presented for (i) calling home; (ii) receiving calls when roaming, and (iii) calling a fixed line in the roaming location.

The aim of this section is to provide tables of mobile phone costs for all similar packages provided by each service provider in a clear comparable format, thus allowing identification of the cheapest costs available when choosing between similar packages. We also provide a number of policy recommendations related to pricing and provision of consumer information.

An Analysis of Mobile Phone Calling Costs in Northern Ireland and the Republic of Ireland

1. Background

There are 215 million GSM (Global System for Mobile Communication) users in Europe. This figure is predicted to reach 733 million by 2004 [1]. The Republic of Ireland's mobile phone sector is expanding at the third fastest rate in Western Europe. In October 2000, mobile penetration was estimated to be just below 50% with 1.86 million subscribers [2]. There is approximately 47% mobile phone penetration in Northern Ireland [3].

Mobile phone usage may be categorised into voice, data and SMS (Short Message Service), and the growth of the latter in the Republic of Ireland and elsewhere is an extremely interesting phenomenon. SMS allows users to send text messages of up to 160 characters and its popularity may be attributed to the fact that it is intimate, personal and straight to the point. Text messaging is the most widely used mobile application worldwide with 10 billion messages sent each month [4]. We have primarily concentrated on voice call costs in this report as the pricing structures associated with SMS and data are straightforward.

Recently a new data technology has emerged which allows limited (primarily textual) Internet services using a mobile phone. WAP (Wireless Application Protocol) allows users to view WAP enabled sites with their mobile phone. The user can make bookings, conduct online purchases and use online banking. WAP is still in its infancy and is the least popular of the services. However, a recent report predicted that WAP would surpass PC usage as the most popular means for accessing the Internet by 2003 [4].

OFTEL (Office of Telecommunications, UK) is currently investigating competition in the UK mobile market. Its initial findings indicate that consumers are not getting the best possible rates, most notably with international roaming and when calling other mobile networks. In addition, OFTEL points out that consumers are confused by the amount of mobile tariffs and products currently on offer [5]. It has even been suggested in one report that evaluating mobile tariffs has become more complicated than completing tax forms [6]. Another recent article in an Irish newspaper commented on the significant volume of information that consumers have to sift through in order to make an informed decision on which phone and calling package to purchase [7]. A calling package may be described as (i) a monthly calling package, which has a fixed monthly rate that includes free calling minutes; (ii) a prepay calling package, where a customer buys a mobile phone and thereafter purchases credit in advance of making calls (there is no fixed monthly charge).

To date, it would appear that no comprehensive study of mobile products available in Northern Ireland and the Republic of Ireland has been completed. This section has two main objectives. First, it provides a comprehensive evaluation of the various calling packages on offer by mobile service providers in both states; second, it provides a number of policy recommendations related to pricing and

provision of consumer information. In particular, we establish the cheapest calling costs when choosing between similar packages offered by different service providers. This was not a simple task, however, as calling costs are not only dependent on the duration of the phone call, but also on the type of network invoked and a thorough understanding of the package pricing structures. As noted earlier, these structures are not normally directly comparable and required the development of specialised, custom-written software to produce the data presented here. The software utilised tariff data (where available) from the service providers, and tariff models designed by the research team to calculate costs. This software and a public information system (www.b4ucall.com) utilising the results are described elsewhere in this publication.

We limit the analysis presented here to national and cross-border usage, which we define as one of the following types of call: (i) calling a fixed national line within the same state, (ii) calling a number within the same mobile network, (iii) calling a number on a different mobile network but within the same state, (iv) calling a cross-border number (calling Northern Ireland from Republic and vice versa) and (v) making calls while roaming (using a handset abroad) on a cross-border network.

We analyse the costs of making these types of call for each service provider currently operating in Northern Ireland (BTCellnet, Orange, and Vodafone) and each service provider in the Republic of Ireland (Eircell and Esat Digifone). The data and figures shown in the tables in this report were generated using software developed by the research team based on figures made available by the service providers [8].

2. Introducing the Service Providers

There are currently two service providers in the Republic of Ireland: Eircell and Esat Digifone. A third service provider, Meteor, has been granted a mobile licence and is due to launch on 22 February 2001. There are three mobile service providers in Northern Ireland: BTCellnet, Orange and Vodafone. Each service provider offers monthly and prepay packages. All packages have roaming and international rates.

(i) Eircell: Eircell is the largest service provider in the Republic of Ireland. It offers one prepay package called “Ready To Go”, and offers a number of personal and business monthly packages. In addition to the standard personal and business monthly packages, it offers global packages for both categories, which provide cheaper international rates for a higher monthly rental. Finally, Eircell offers two upfront packages allowing a customer to pay a set amount upfront

that covers one year's monthly rental including free minutes. Most monthly package names start with "Eirtime" for personal packages and "Sharetime" for business packages, followed by the number of inclusive minutes, e.g. Eirtime10 and Sharetime500.

(ii) Esat Digifone: Esat Digifone offers two prepay packages "Earlybird" and "Nightowl". These packages vary depending on which hours are regarded as peak. In addition, it offers three personal monthly packages: "Select 1", "Select 2" and "Select 3". They do not offer upfront or business packages.

(iii) BTCellnet: BTCellnet offers two prepay packages called "Pay As You Go" and "Pay As You Go plus free best friend". It offers a number of personal monthly packages and one business monthly package. In addition it offers an upfront package allowing a customer to pay a set amount upfront that covers one year's monthly rental and includes free minutes. Most monthly packages are preceded by "Net" or "My Time Net", followed by the number of inclusive minutes e.g. Net100 and MyTimeNet200.

(iv) Vodafone: Vodafone offers three prepay packages called "Pay As You Talk" and "Pay As You Talk - All Calls" and "Pay As You Talk - Original". It offers a number of personal and business monthly packages. In addition, it offers a number of group saver options, which allow customers to share monthly inclusive minutes over a number of different handsets. Most monthly packages are preceded by "VF" or "Leisure" and followed by the number of inclusive minutes e.g. VF20 and Leisure200.

(v) Orange: Orange offers one prepay package called "Just Talk". It offers a number of personal monthly packages. Most monthly packages start with the pretext "Talk" followed by the number of monthly inclusive minutes, e.g. Talk60 and Talk150.

This report compares similar personal monthly and prepay packages offered by these five service providers. It is important to note at this stage that a Republic of Ireland customer who wishes to purchase a mobile business package or an upfront package has no option but to do so under Eircell. As we are only concerned with comparing similar products, we only compare the prepay packages, and compare Esat Digifone personal monthly packages with Eircell's equivalents. All other packages are excluded. Additionally, we recognise that all service providers will offer unique features that are beyond the scope of this report.

3. Cross-Border Calling Costs

This section details the cheapest calling rates when calling Northern Ireland (NI) from the Republic of Ireland (ROI) and vice versa.

(i) Call costs to Northern Ireland from the Republic of Ireland

The customer will be using an Eircell or Esat Digifone package to make this call. We base our observations on the data presented in Figure 2.1 and Figure 2.2. All prices quoted are in Punts (Irish) per second and are inclusive of VAT.

Monthly Customers:

- Calls to Northern Ireland with any Eircell monthly package are charged at the same rate as calls to national fixed numbers and not as international calls.
- It is cheaper to phone Northern Ireland using any Eircell monthly package than any Esat Digifone package at off peak and weekend times.
- The only time it is more expensive to phone Northern Ireland with Eircell than Esat Digifone is at peak times on Eirtime10. For all other packages Eircell is the best choice.
- Esat Digifone offers World Plus, an additional option, which costs IEP£5.00 extra per month. At peak times, using World Plus, it is between 7p and 27p cheaper to call Northern Ireland than it is with Eircell.
- Even with Esat Digifone's World Plus option, it is still cheaper to call on any Eircell package at the weekend.
- In general, we believe that Eircell offers the best rates for calling Northern Ireland.

	Eirtime10	Eirtime50	Eirtime100	Esat	Esat Digifone (with World Plus)
Peak	0.50	0.36	0.30	0.45	0.23
Off-Peak	0.20	0.18	0.15	0.35	0.18
Weekend	0.12	0.12	0.12	0.35	0.18

Figure 2.1 Calls from a monthly ROI package to a NI network.

Prepay Customers:

- It is cheaper at all times to call Northern Ireland using an Esat Digifone prepay package than using an Eircell prepay package.

	Ready To Go	Esat Digifone: EarlyBird	Esat Digifone: Nightowl
Peak	0.80	0.75	0.75
Off-Peak	0.80	0.75	0.75
Weekend	0.80	0.75	0.75

Figure 2.2 Calls from a prepay ROI package to a NI network.

(ii) Call costs to the Republic of Ireland from Northern Ireland

The customer will be using a BTCellnet, Orange or Vodafone package to make this call. We base our observations on the data presented in Figure 2.3. All prices quoted are in Pounds (Sterling) per second and are inclusive of VAT.

Monthly Customers:

- On 1st February 2001, Orange introduced a flat rate for calling the Republic of Ireland of 15p at all times. Orange, therefore, offers the cheapest rate to call the Republic of Ireland at all times.

- For an additional £2.99 per month customers can avail of BTCellnet's International Traveller Service; this reduces call costs to 0.18p at peak times and 0.15p at off peak times.

	BTCellnet	Vodafone	Orange
Peak	0.94	0.74	0.15
Off-Peak	0.94	0.37	0.15
Weekend	0.94	0.37	0.15

Figure 2.3 Calls from a monthly NI package to an ROI network.

4. Cross-Border Roaming Costs

The term roaming refers to using a mobile phone abroad. For the purposes of this report it means using either an Eircell or Esat Digifone handset in Northern Ireland, or using a BTCellnet, Orange or Vodafone handset in the Republic of Ireland. It is important to note that, when roaming, be it with a Northern Ireland or Republic of Ireland network, calls are charged as a rule on a per minute basis and not on a per second basis.

(i) Roaming on a Northern Ireland network

The customer will be using either an Eircell or Esat Digifone package to make this call. We base our observations on the data presented in Figures 3.1 - 3.3. All prices quoted are in Irish Punts per minute and are inclusive of VAT.

Monthly Customers:

- Esat Digifone customers receive cheaper incoming call rates (22p cheaper at off-peak times on all three Northern Ireland networks) when roaming with all networks, as all three Northern Ireland service providers charge the same rates for incoming calls.

- When making a national call, Orange is the cheapest network to roam with for both Eircell and Esat Digifone customers. We believe that a national call is one to a fixed line in Northern Ireland, as the service providers' documentation is unclear on an exact specification for the term 'national call'.

- Making a national call when roaming is most expensive with Vodafone for both Esat Digifone and Eircell customers.

- In all instances, off-peak rates are substantially cheaper for Esat Digifone customers. However, Esat Digifone off-peak rates start between 21:30-22:00 and end at 07:30-09:00 (depending on the roaming partner) whereas Eircell rates apply at all times.

- When "calling home" i.e. calling the Republic of Ireland, when roaming, Orange is the cheapest network for both Esat Digifone and Eircell customers at peak times. At off-peak times, Vodafone is the cheapest roaming partner for Esat Digifone (see Figures 3.1 - 3.2).

	Incoming	National	Calling home
Orange: Peak	0.54	0.32	0.98
Orange: Off-Peak	0.54	0.32	0.98
BTCellnet: Peak	0.54	0.36	1.05
BTCellnet: Off-Peak	0.54	0.36	1.05
Vodafone: Peak	0.54	0.52	1.00
Vodafone: Off-Peak	0.54	0.52	1.00

Figure 3.1 Roaming Costs for an Eircell customer roaming on a NI network.

	Incoming	National	Calling home
Orange: Peak	0.44	0.34	1.05
Orange: Off-Peak	0.32	0.17	0.70
BTCellnet: Peak	0.44	0.38	1.12
BTCellnet: Off-Peak	0.32	0.19	0.69
Vodafone: Peak	0.44	0.55	1.07
Vodafone: Off-Peak	0.32	0.22	0.59

Figure 3.2 Roaming Costs for an Esat Digifone customer roaming on a NI network.

Prepay Customers:

- Esat Digifone customers receive the cheapest rates for incoming calls. Both Eircell and Esat Digifone customers receive the same rates for calling home and making national calls, and these rates are substantially more expensive than the rates while roaming with a monthly package.

	Incoming	National	Calling Home
ESAT DIGIFONE - all networks*	1.00	1.50	1.50
EIRCELL - all networks*	1.50	1.50	1.50

Figure 3.3 Roaming Costs for prepay customers roaming on a NI network.

*Prices are the same regardless of whether the roaming network is BTCellnet, Vodafone or Orange.

(ii) Roaming on a Republic of Ireland network

The customer will be using a BTCellnet, Orange or Vodafone package to make this call. We base our observations on the data presented in Figures 3.4 - 3.6. Except where indicated, all prices quoted are in Pounds (Sterling) per minute and are inclusive of VAT.

Monthly Customers:

- Esat Digifone and Eircell both charge each Northern Ireland network the same price for incoming calls, although the actual charge differs for each Northern Ireland service provider. For example, BTCellnet customers are charged per minute, which is 74p more expensive than charged to Orange, and 35p more expensive than charged to Vodafone. This has a substantial impact on the choice of roaming partner for receiving calls when roaming in the Republic of Ireland.

- For all call types (incoming, national and calling-home) for any Orange package, Esat Digifone charge on a per second basis, whereas Eircell bills on a per 30 second basis - therefore Orange customers should select Esat as their roaming partner. It appears from our reading of the available data that this is not the case for BTCellnet and Vodafone customers, as these service providers are charged on a per minute basis by both Eircell and Esat Digifone. Unfortunately, the data both for BTCellnet and Vodafone are ambiguous in relation to these charges.

- BTCellnet customers receive the cheapest rates for calling national numbers within the Republic of Ireland irrespective of roaming partner.

- There is no significant difference between Esat Digifone and Eircell charges to Northern Ireland customers for national calls and calling home. BTCellnet customers get the most favourable rates, however.

- For an additional £2.99 per month a customer can sign up for BTCellnet's International Traveller Service. This reduces incoming calls to 18p per minute at peak times and 15p per minute at off peak times.

	Incoming	National	Calling home
Esat Digifone	0.94	0.23	0.52
Eircell	0.94	0.25	0.45

Figure 3.4 Roaming Costs for a BTCellnet customer roaming on a ROI network

	Incoming	National	Calling home
Esat Digifone	0.20	0.40	0.40
Eircell	0.20	0.40	0.40

Figure 3.5 Roaming Costs for an Orange customer roaming on a ROI network

	Incoming	National	Calling home
Esat Digifone	0.59	0.25	0.56
Eircell	0.59	0.27	0.49

Figure 3.6 Roaming Costs for a Vodafone customer roaming on a ROI network

Prepay Customers:

Currently, it is not possible to roam in the Republic of Ireland with a Northern Ireland prepay package.

5. Calling Costs within the Same State

In both Northern Ireland and the Republic of Ireland, call costs are charged on a per second basis for fixed-line, same-network and other mobile network calls.

(i) Calls within the Republic of Ireland

The customer will be using an Eircell or Esat Digifone package to make this call. We base our observations on the data presented in Figure 4.1 and Figure 4.2. All prices quoted are in Punts (Irish) per second and are inclusive of VAT.
Monthly Customers:

Esat Digifone offers three personal monthly options. Eircell currently offers thirteen personal monthly options plus a number of business options. As this report is concerned with evaluating similar packages to establish the cheapest calling rates, only the three Esat Digifone packages and their Eircell equivalents are analysed and presented here.

- With all Eircell monthly packages a customer can nominate another number within the Eircell mobile network that they can call for free. The "free" value is the equivalent of the number of inclusive minutes for the package to which they subscribe. For example, if they are on Eirtime 50 they can call a nominated Eircell number for 50 minutes at no cost each month. These minutes can only be used at weekend and off-peak times.

- Both service providers offer inclusive monthly minutes in all monthly packages. However Esat Digifone includes this as a monetary equivalent: for example, Esat Digifone gives £6.00 worth of free calling minutes, which is equivalent to 10 off-peak minutes. With both service providers the inclusive minutes can be used at any time of the day, except for Eircell's Timeout200. However, as peak rates are higher, Esat Digifone inclusive minutes will disappear faster if used at peak times.

- With Esat Digifone's Select 2 and Select 3 packages, bulk discounts apply for calls made to fixed-line numbers at peak times. If more than 60 minutes of calls are made at peak time then a cheaper rate applies. A further reduction applies above 120 minutes.

- Making calls to fixed-line numbers is cheaper with Esat Digifone (at peak and off-peak times). With Esat Digifone's bulk discounts, the call costs are further reduced. The cost of calling a fixed-line number at the weekend is the same for both Eircell and Esat Digifone.

- It is cheaper to call from Esat Digifone to Eircell during peak times, but at off-peak and weekend times it is cheaper to call from Eircell to Esat Digifone.

- The costs of making calls within the same network for the specified packages (i.e. Esat Digifone to Esat Digifone, Eircell to Eircell) are the same for both service providers at all times.

	Eirtime10	Select 1	Eirtime50	Select 2	Eirtime100	Select 3
Fixed: peak	0.50	0.42	0.36	0.24	0.30	0.21
Fixed: off-peak	0.20	0.12	0.18	0.12	0.15	0.12
Fixed: weekend	0.12	0.12	0.12	0.12	0.12	0.12
Other: peak	0.50	0.48	0.36	0.24	0.30	0.24
Other: off-peak	0.20	0.24	0.18	0.24	0.15	0.24
Other: weekend	0.12	0.24	0.12	0.24	0.12	0.24
Same: peak	0.12	0.12	0.12	0.12	0.12	0.12
Same: off-peak	0.12	0.12	0.12	0.12	0.12	0.12
Same: weekend	0.12	0.12	0.12	0.12	0.12	0.12

Figure 4.1 Comparison between monthly package calling charges for Eircell and Esat Digifone

Prepay Customer:

- Esat Digifone offers two prepay packages: "Speakeasy Earlybird" and "Speakeasy Nightowl". These packages differ when off peak rates apply: with Earlybird, off-peak hours are 07:00 to 15:00 and with Nightowl, off-peak hours are 18:00 to 07:00. Eircell offers one prepay package: "Ready To Go".

- Calling within the same network is cheaper with Eircell than Esat Digifone.

- Off-peak rates to fixed-line or other networks are cheaper with Eircell than with Esat Digifone.

- Call costs at the weekend are the same for all packages with both service providers.

	Ready To Go	Earlybird	Nightowl
Fixed / Other network: Peak	0.50	0.50	0.50
Fixed / Other network: Off-Peak	0.20	0.15	0.15
Fixed / Other network: Weekend	0.10	0.10	0.10
Same network: Peak	0.40	0.50	0.50
Same network: Off-Peak	0.10	0.15	0.15
Same network: Weekend	0.10	0.10	0.10

Figure 4.2 Comparison between prepay calling charges for Eircell and Esat Digifone

(ii) Calls within Northern Ireland

The customer will be using a BTCellnet, Orange or Vodafone package to make this call. We base our observations on the data presented in Figures 4.3 - 4.7. Except where indicated, all prices quoted are in Pounds (Sterling) per second and are inclusive of VAT.

Monthly Customer:

- There is a vast amount of monthly packages available in the UK. A selection of these packages is compared and analysed here. Although we have generated the data using our software, a full analysis of these packages is beyond the scope of this report. We believe that the following set of comparisons are representative of the full data set, however.

- Without exception, BTCellnet have the most expensive calling rates. Additionally, BTCellnet have a minimum charge of 2 pence per call. However, all BTCellnet packages have more inclusive minutes than equivalent packages with the other service providers.

- Calling within the same network is cheapest with Vodafone.

- Calling other networks is cheapest with Orange.

	BTNet100	Orange Talk 60	Vodafone 60
Fixed: Peak	0.18	0.15	0.15
Fixed: Off-peak	0.05	0.05	0.05
Fixed: Weekend	0.02	0.05	0.05
Other: Peak	0.50	0.30	0.50
Other: Off-peak	0.35	0.12	0.30
Other: Weekend	0.35	0.12	0.30
Same: Peak	0.18	0.15	0.10
Same: Off-peak	0.10	0.05	0.05
Same: Weekend	0.10	0.05	0.05

Figure 4.3 Comparison between similar Northern Ireland monthly package calling charges

	BTNet200	Orange Talk 150	Vodafone 150
Fixed: Peak	0.18	0.15	0.10
Fixed: Off-peak	0.05	0.05	0.05
Fixed: Weekend	0.02	0.05	0.05
Other: Peak	0.50	0.30	0.50
Other: Off-peak	0.35	0.12	0.30
Other: Weekend	0.35	0.12	0.30
Same: Peak	0.18	0.10	0.10
Same: Off-peak	0.10	0.05	0.05
Same: Weekend	0.10	0.05	0.05

Figure 4.4 Comparison between similar Northern Ireland monthly package calling charges

Prepay Customer:

- The prepay packages currently on offer are not easily compared due to the substantially different pricing structure associated with the packages.
- For calling fixed-line networks BTCellnet's "Pay As You Go" offers the cheapest rates for prepay customers. It also offers the cheapest rates for calling within the same network.
- Orange calling rates are based on the value of the calling card purchased. Purchasing a card for £50.00 means reduced rates to fixed networks and other Orange numbers.
- Vodafone offers the best packages for calling other networks.

	Pay As You Go	Pay As You + Free Best Friend
Fixed: Peak	0.25	0.30
Fixed: Off-peak	0.10	0.30
Fixed: Weekend	0.02	0.30
Other: Peak	0.10	0.30
Other: Off-peak	0.10	0.30
Other: Weekend	0.02	0.30
Same: Peak	0.50	0.30
Same: Off-peak	0.25	0.30
Same: Weekend	0.25	0.30

Figure 4.5 BTCellnet prepay package calling charges

	Just Talk £5.00	Just Talk £10.00	Just Talk £15.00	Just Talk £25.00	Just Talk £50.00
Fixed: Peak	0.35	0.35	0.35	0.35	0.25
Fixed: Off-peak	0.10	0.10	0.10	0.10	0.05
Fixed: Weekend	0.10	0.10	0.10	0.10	0.05
Other: Peak	0.20	0.20	0.20	0.20	0.15
Other: Off-peak	0.10	0.10	0.10	0.10	0.05
Other: Weekend	0.10	0.10	0.10	0.10	0.05
Same: Peak	0.50	0.50	0.50	0.50	0.50
Same: Off-peak	0.25	0.25	0.25	0.25	0.25
Same: Weekend	0.25	0.25	0.25	0.25	0.25

Figure 4.6 Orange prepay package calling charges

	Pay As You Talk	Pay As You Talk All Calls	Pay As You Talk Original
Fixed: Peak	All networks	0.35	0.35
Fixed: Off-peak	are	0.10	0.05
Fixed: Weekend	charged at	0.05	0.02
Other: Peak	25p for the	0.35	0.35
Other: Off-peak	first 3 minutes	0.10	0.05
Other: Weekend	and at	0.05	0.02
Same: Peak	5p thereafter.	0.35	0.50
Same: Off-peak		0.10	0.30
Same: Weekend		0.05	0.30

Figure 4.7 Vodafone prepay package calling charges

6. SMS and WAP Costs

(i) SMS and WAP costs in the Republic of Ireland

The customer will be using an Eircell or Esat Digifone package to use these services. We base our observations on the data presented in Figure 5.1 and Figure 5.2. All prices quoted for SMS are in pence (Irish) per message and are inclusive of VAT. All prices quoted for WAP are in pence (Irish) per minute and are inclusive of VAT.

Monthly Customers

- Esat Digifone offer cheaper rates for sending SMS messages.
- WAP costs are the same on both networks, except for Eirtime10.

	Eirtime10	Select 1	Eirtime50	Select2	Eirtime100	Select3
SMS	12p	9p	12p	9p	12p	9p
WAP	50p peak 20p off peak 12p weekend	12p	12p	12p	12p	12p

Figure 5.1 Monthly package SMS and WAP in the Republic of Ireland

Prepay Customers

- Both networks offer the same rates for sending SMS messages.
- WAP costs are cheaper at all times with Esat Digifone.

	Ready To Go	Earlybird	Nightowl
SMS	10p	10p	10p
WAP	35p peak 10p off peak 10p weekend	15p peak 5p off-peak 5p weekend	15p peak 5p off-peak 5p weekend

Figure 5.2 Prepay package SMS and WAP in the Republic of Ireland

(ii) SMS and WAP costs in Northern Ireland

The customer will be using a BTCellnet, Orange or Vodafone package to use these services. We base our observations on the data presented in Figure 5.3 and Figure 5.4. All prices quoted for SMS are in pence (Sterling) per message and are inclusive of VAT. All prices quoted for WAP are in pence (Sterling) per minute and are inclusive of VAT.

Monthly Customers

- Orange offers the cheapest cost for sending SMS messages.
- WAP costs are cheaper at all times with Orange.

	BTNet100	Orange Talk 60	Vodafone 60	BTNet200	Orange Talk 150	Vodafone 150
SMS	12p	7p	12p	12p	6p	12p
WAP	10p	5p		10p	5p	

Figure 5.3 Monthly package SMS and WAP in Northern Ireland

Prepay Customers

- Orange offers the cheapest cost for sending SMS messages.
- WAP costs are the same for all service providers.

	Vodafone Pay As You Talk	Vodafone Pay As You Talk All Calls	Vodafone Pay As You Talk Original	Orange £5, £10, £15, £20, £25	Orange £50	BTCellnet Pay As You Go	BTCellnet Pay As You + Free Best Friend
SMS	12p	12p	12p	10p	5p	10p	10p
WAP	10p	10p	10p	10p	10p	10p	10p

Figure 5.4 Prepay package SMS and WAP in Northern Ireland

7. Costings Summary and Policy Recommendations

We have provided a comprehensive evaluation of the various calling packages on offer by mobile service providers in both Northern Ireland and the Republic of Ireland. We have established, where possible, the cheapest calling costs when choosing between similar packages offered by different service providers and provided detailed costings tables for cross-border calls, cross-border roaming calls, calls within the same state, and WAP and SMS calls. As calling costs are not only dependent on the duration of the phone call but also on the type of network invoked, a thorough examination of the package pricing structures was first undertaken. Using these structures, which are not normally directly comparable, we developed specialised software to produce the data presented in the previous sections. The software utilised tariff data (where available) from the service providers, and tariff models designed by the research team to calculate costs. The rest of this section summarises some of the major findings, and suggests a number of policy recommendations related to pricing and provision of consumer information.

In most instances, it is cheaper to call Northern Ireland on an Eircell monthly package than on an Esat Digifone monthly package. However, paying extra for "World Plus" with Esat Digifone will result in cheaper costs at peak times. It is cheaper to call Northern Ireland with an Esat Digifone prepay package than an Eircell prepay package.

Orange offers the cheapest monthly package rates to call the Republic of Ireland from Northern Ireland at all times. Orange is also the cheapest network for both Esat Digifone and Eircell customers "calling home" from Northern Ireland at peak times. At off-peak times Vodafone is cheaper for Esat Digifone customers. It is cheaper for an Esat Digifone prepay customer to roam cross-border with all Northern Ireland networks than an Eircell prepay customer. Orange customers receive the most favourable roaming rates in the Republic of Ireland except when making national calls. In this instance BTCellnet customers receive the most favourable rates. An Orange customer should choose Esat Digifone over Eircell, however, as Eircell charge on a per 30 second basis and Esat Digifone charge on a per second basis.

Deciding between any monthly or prepay package for making calls within the same state, be it within Northern Ireland or the Republic of Ireland, depends on the type of network most often called and the time of day when most calls are made.

We find that for the monthly packages evaluated and presented in this report, calls to fixed-line numbers are cheaper with Esat Digifone; calls to other networks during the day are cheaper with Esat Digifone and are cheaper with Eircell at off-peak and weekend times. Call charges within the same network are the same for both service providers. There is very little difference between the prepay

packages provided by both Republic of Ireland service providers. In Northern Ireland, calls to fixed-line numbers with Vodafone packages are marginally cheaper than for the other two service providers; calls to other networks are cheapest with Orange; calls within the same network are marginally cheaper with Vodafone packages. BTCellnet's "Pay As You Go" package appears to be the cheapest prepay package for Northern Ireland customers.

We would recommend that all service providers should be obliged to provide detailed costings in summarised format in order that existing and potential customers may accurately determine the most suitable package. We believe that customers should not have to sift through mounds of heuristic-based data in order to make decisions. In many cases comparisons of packages appear too difficult, as it is a complex task to compare heuristics. The customer depends on marketing, advertising, personal opinion and hearsay when choosing a package. We would favour the publication of simple tabular data providing the actual cost for calls of fixed duration for every call type. This is particularly relevant for roaming costs. In the interim, we have calculated these tables for each of the five service providers and have made the data publicly available using an Internet information server. This server is described in detail in Section Three of this report.

Consumers need to be made aware that per second billing does not apply to roaming costs and that the user pays per minute in most cases. Also consumers need to be advised on what network to select when roaming. Roaming prices for "calling home" for Republic of Ireland users (when in Northern Ireland) should be addressed through the tariff authorities in the Republic of Ireland, as prices there are much higher than for Northern Ireland users roaming in the Republic. In general, packages provided by service providers in the Republic of Ireland are more expensive than similar packages provided in Northern Ireland.

Although this report is comprehensive in and of itself, it is only one facet of a larger area. The data and figures we presented are a subset of those we researched. Time and resources permitting, further results and analyses can be obtained from the software developed.

Last minute Addendum

An excellent article entitled "International roaming charges: over-charging and competition law", by E. Sutherland, has just appeared in the journal *Telecommunications Policy*, volume 25, pp. 5-20, 2001. Among the cases discussed are the Irish and UK ones. An appendix provides a set of 10 recommendations by the International Telecommunications Users Group (INTUG), Brussels.

References

[1] "GSM users to surpass 730m by 2004", GSM Association, Nua Internet Surveys, July 2000

[2] "More Competition evident in the Telecoms market", ODTR, http://www.odtr.ie/docs/pres280900.doc, Sept 2000

[3] "Consumers' use of mobile telephony " OFTEL, http://www.oftel.gov.uk/cmu/research/ Aug 2000

[4] "Mobile Phone to become main access device", CNET, Nua Internet Surveys, Nov 2000

[5] "First stage of mobile market review", OFTEL, http://www.oftel.gov.uk/releases/2001. Feb 2001

[6] "Mobile Phone Companies ripping us off", Kieran Mc Carthy , http://www.theregister.co.uk Feb 2000

[7] "Competition getting more Spirit", Eddie Lennon, Irish Independent, 20 Jan 2001

[8] http://www.eircell.ie/
http://www.digifone.com/
http://www.orange.co.uk/
http://www.btcellnet.net/
http://www.vodafone.co.uk/
Service Provider brochures.

5

The Advantages of Developing Telecardiology Services in Ireland

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Preamble

"Cross-border hospitals' work clear queues - Belfast aid for Cork cardiac test backlog" read the *Belfast Telegraph* on 28 August 2000. The work in question was that of Geraldine McParland, who has compiled and written the following section. The *Belfast Telegraph,* echoed by the *Irish Times,* reported how staff shortages in Cork University Hospital had led to a call for backup aid by specialist staff in Belfast City Hospital.

The backup aid was based on remote diagnosis. The patient's heart data is uploaded to the diagnosis centre by modem, or in the case of pacemaker calibration and checking, by a special acoustic coupler. Images such as ultrasound are sent as email attachments. Diagnosis can be in real time - to reassure the patient, arrange for further tests at a convenient time, or organise immediate urgent intervention. Rural areas in particular have much to gain from such telemedicine systems. There is great robustness in such a system: a lack of available staff at one location is remedied by putting the data and voice calls through to a backup centre of expertise. Ambulance costs in taking elderly or infirm patients to a local data collection centre can be spared, at very considerable cost. Time-critical aspects of health care can be overcome.

This section details current practice in the Belfast area. The cost savings which are feasible in generalizing this telemedicine system in the Republic are quantified. Such telemedicine technology points to a clear win-win situation for all concerned - improved health care at considerably lower cost, and providing a scalable and robust system relative to the future needs of our society on both sides of the Irish border.

Summary

Speed and accuracy of diagnosis are the important aspects of delivering a good cardiology service. Cardiac patients may be put at risk in areas where long waiting times for diagnostic tests exist. There is also the argument that the patient will always benefit most from the expertise of a specialist in delivering their health care.

The Advantages of Developing Telecardiology Services in Ireland

- This report will explain how transtelephonics can be used in cardiology to speed up diagnosis and provide geographically remote patients and their GPs with the expertise of the specialist.
- It will also sketch out how the present systems may be developed and used more extensively, not only to diagnose, but to actually deliver therapy.
- It will explain how telemedicine is used in four separate areas of cardiology at the Belfast City Hospital (BCH).
- A list of advantages to the patient as well as to the health care professionals will be highlighted.
- The cost effectiveness of expanding this service to other areas of Ireland will be calculated.

1. Development of Telemedicine

Telemedicine is defined as the "delivery of health care and sharing of medical knowledge over a distance using telecommunication systems." The concept is not new. There have been numerous attempts to develop telemedicine programmes, especially in the 1960s. These early attempts looked encouraging but lacked the technology to be of any great use. The 1970s and 1980s offered little also. It was not until the 1990s that this area really took off. The Belfast City Hospital was the first to use transtelephonic transmission of electrocardiographs (ECGs) to GPs in Ireland and the UK. The use of in-house transtelephonic ECGs was first developed in the late 1980s, and an ECG overreading service to GPs was started as a pilot study in January 1990.

Clinical applications in telemedicine are found today in many specialities. Recent work carried out by Gustke and colleagues at the East Carolina University, looking at the profile of users of real-time interactive teleconferencing in clinical consultations, states that the largest number of referrals was made in dermatology to obtain a second opinion or to ask for recommendations on management. The second largest use was in cardiology, for the same reasons. Thrall and Boland in the Department of Radiology, Massachusetts General Hospital, Boston, reaffirm these findings.

Although the technology is available to offer these services in Ireland, and the advantages to the patients are greater in this country, due to its remote geographical setting, few centres use this method to deliver cardiology services.

2. ECG Transmission

The Belfast City Hospital first used the transtelephonic system in electrocardiography (ECGs). This is a first-line diagnostic test used to help diagnose patients with suspected cardiac disease. Most GPs throughout the country have a portable ECG machine and are proficient at delivering the correct diagnosis. There are however some tracings which require an expert to interpret.

HEARTFAX, an ECG overreading service for GPs and occupational health departments, was introduced in the BCH in 1990. Today there are 14 health centres, each with 2 to 12 doctors using the service. The ECG is overread by a cardiologist.

The advantages to the patient are immense. The diagnosis is made by the expert. If there is nothing acute the patient will be reassured. If there is something which requires immediate attention the patient will be seen immediately.

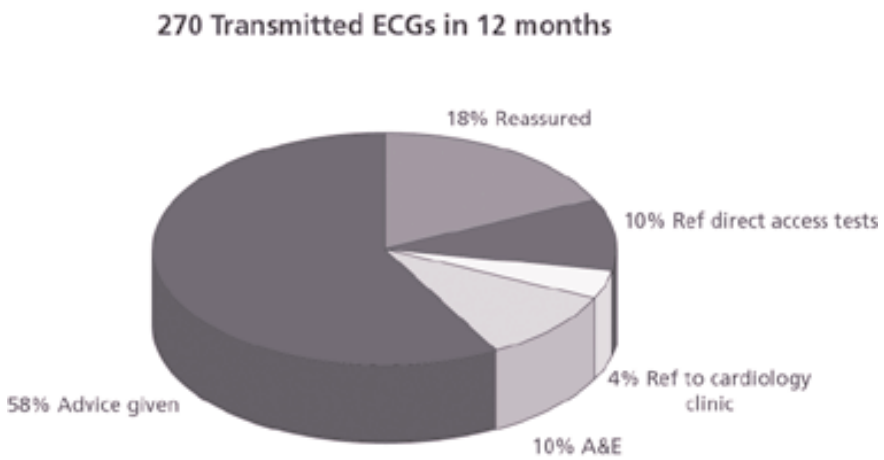

Figure 1. ECG transmissions for year 2000 at Belfast City Hospital.

The above chart is a breakdown of transmissions for year 2000 at BCH.

The advantage to the health care professional lies in the confidence that the correct diagnosis and advice on management has been sought.

Other advantages are that patients with heart disease are referred to see the consultant cardiologist with priority rating and those who have no clinical indicators and an ECG within normal limits are reassured. This helps prevent unnecessary referrals, thus helping to reduce waiting lists.

The Advantages of Developing Telecardiology Services in Ireland

In 1996 H.S. Rissam et al. at the Department of Telecardiology, Escorts Heart Institute and Research Centre, New Delhi, India, set up a clinic for the evaluation of cardiac symptoms by transtelephonic electrocardiographic monitoring (TTEM). Not only was the patient data transmitted from Delhi and elsewhere in India, but they also accepted transmissions from other neighbouring countries. This is a concept which may be considered throughout the whole of Ireland. This would allow an individual GP or local hospital to transmit to any centre in Ireland, North or South, which offered the service.

At the moment there are three hospitals in the North offering an overreading service. To my knowledge none are offered in the South.

3. Satellite Echo Clinics

The second service offered is to patients requiring heart scans using ultrasound. These scans need to be recorded by well-trained sonographers who travel from the regional centre to the local hospitals to do echo clinics. The scans are usually reported by these sonographers who require a facility to liaise with a consultant cardiologist, specialised in this field, for advice on findings on the scans. The findings themselves quite often require immediate clinical advice about the management of the patient from the cardiologist to the physician treating the patient.

There are two local hospitals linked to the Belfast City Hospital by ISDN lines, one 10 miles away and the other 24 miles away. This provides the facility to obtain advice on the images or reports when required. The local physician and consultant can view the scan simultaneously and discuss possible management of the patient. This is instantaneous and therefore means a tape or disk is not required to be sent through the post or to be delivered by hand.

The service is also cost effective. In the year 1998, before the service started, the total cost for transporting 186 patients to the regional hospital was £21,367. The following year the number of in-patient echoes performed, after the remote service was set up, was 370. This meant a saving of £38,169. The equipment thus paid for itself, on both sites, in two years.

The Royal Victoria Hospital, the other regional cardiology centre in Northern Ireland, offers paediatric echo satellite clinics to four district hospitals, and an overreading service to paediatric patients at one site 100 miles away.

Figures show that in seven hospitals in the Republic of Ireland the shortest distance travelled by patients in ambulance to have an echo done ranges from 1 to 5 miles. The longest distance travelled ranges from 10 to 240 miles. Two hundred and seventy nine patients are transported to these seven hospitals per month, resulting in approximately 3,348 patients per year. Cork University

Hospital performed 33 echoes on patients from Tralee General Hospital in the month of January. Ten patients travelled by ambulance 158 miles each, totalling 1580 miles per month @ £5.77 per mile. Thus transport costs for one area for one month was £9,116. Total cost per year for transportation can be estimated at £109,392!

Literature shows that as far back as 1987 Finley et al. established a paediatric cardiology real-time echocardiography service using telemedicine at the Department of Cardiology in Grace Health Centre in Halifax, Nova Scotia, Canada. The service was initially provided to a single hospital and now has been extended to six hospitals. The finding there was that this provides a service at the local hospitals comparable in availability and accuracy to that provided in the regional centre. It also prevents unnecessary transportation of ill patients and is cost effective. This is exactly what we find with the service provided in Belfast. So there is little doubt that this is a tried and tested method of delivering a specialised and cost effective service.

4. Holter Monitoring

Holter monitoring, or 24/48 hour tape analysis from the regional hospital to the local hospital, is the third service which is provided at the Belfast City Hospital. This is where each heartbeat of the patient is monitored over 24 or 48 hours. The heartbeat is recorded by a digital recorder onto a disk and then downloaded onto an analyser. It is used to diagnose patients with abnormal heart rhythms (arrhythmias). Although the recording device is relatively inexpensive, the equipment used to do the analysis is very expensive. Due to this and to the fact that considerable skill is required to interpret these more complex arrhythmias, which may be malignant, the analysers are usually only available in the larger hospitals where a consultant cardiologist is available.

However modern technology has enabled the smaller local hospital to link to the Belfast City Hospital. This again enables regional services to be delivered locally at a fraction of the cost. The local hospital buys the inexpensive recorder and sends the signals down the phone line onto the analyser for analysis at the regional centre. This method also ensures speed of analysis, and thus a fast diagnosis and intervention if appropriate.

This prevents patient travel, time delays, and is very cost effective. Small local hospitals have only to buy the transmitter box at a cost of approximately £6,000 instead of a large analyser of between £30,000-£40,000.

A kilostream line which is continuously open from hospital to hospital carries the signals. There is a set charge for the line which is approximately £2,500 per year. There is no limit to the number of transmissions for this price. There is continuous development in this area and there are other methods of transmitting the data such as email. However the problem with such transmission methods is the risk to patient confidentiality if the file were to be opened by those other than health care workers who are bound by confidentiality. However there is a UK hospital network system which is now in place, and which will eliminate the need for the kilostream line.

The Belfast City Hospital is the only provider of this service in Ireland to date.

5. Pacemaker Parameter Follow-Up Clinics

The final area, and I believe the most significant, where technology is moving rapidly, is in the remote monitoring of pacemaker and automatic implanted cardiac defibrillators. The treatment is mainly used for the elderly who have conduction problems with their heart. In most cases the pacemaker is essential for the maintenance of life itself.

To give an indication of the size of the commitment to these devices at the moment, Belfast City Hospital alone is implanting approximately 400 pacemakers per year. The average life span of each device is approximately eight years. Each device has to be checked at least once per year and sometimes twice. Thus the average number of reviews during the life of the device is 12. At an implant rate of 400 per year, the total number of reviews over an eight-year period would be 4800. If we calculate that only 20% need to travel by ambulance, at an average of only 80 miles round trip, the cost is £443,136. If we then calculate the number of devices reviewed through the whole of Ireland and estimate approximately 1700 implants per year, the figure changes to follow-up costs of £9,416,640 over an eight-year period. This figure is very conservative.

Over one third of pacemaker patients implanted each year at the Belfast City Hospital are over 80 years of age. At present throughout Ireland most review clinics are carried out at the implant centre. This can mean in some cases a patient travelling a 280-mile round trip from Donegal to a regional centre in Dublin to have a 10 minute review. At the Belfast City Hospital the patient attends a local hospital within a 30-mile radius and the follow-up ECG with parameter values is transmitted down the phone line directly from the patient's device. Although this is a basic follow-up, various important information items about the function of the device can be ascertained certainly enough to prevent the patient travelling such great distances.

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The technology of the pacemaker and of the implantable cardiac defibrillator is becoming extremely sophisticated and will require more extended interrogation than that being done at present. However the technology is being developed at the moment by a leading pacemaker company. Clinical trials are starting at the Belfast City Hospital in six months, using this type of equipment.

The reason why pacemaker reviews are necessary is that during the life of the device the patient's cardiac condition may change, thus requiring reprogramming of the pacemaker parameters. If this happens the patient must attend the implant centre to have this function performed.

The next phase of development in this new technology will enable remote reprogramming as well as monitoring for both pacemakers and defibrillators.

The following diagram (Figure 2), courtesy of Medtronic pacemaker company, illustrates the new system.

The extender will sit at the remote site, the programmer at the implant centre. Both devices will communicate through telephone lines.

Data from the devices may also be stored on a server (information network) enabling download of information to other information systems, for example at the physician's or scientific officer's home.

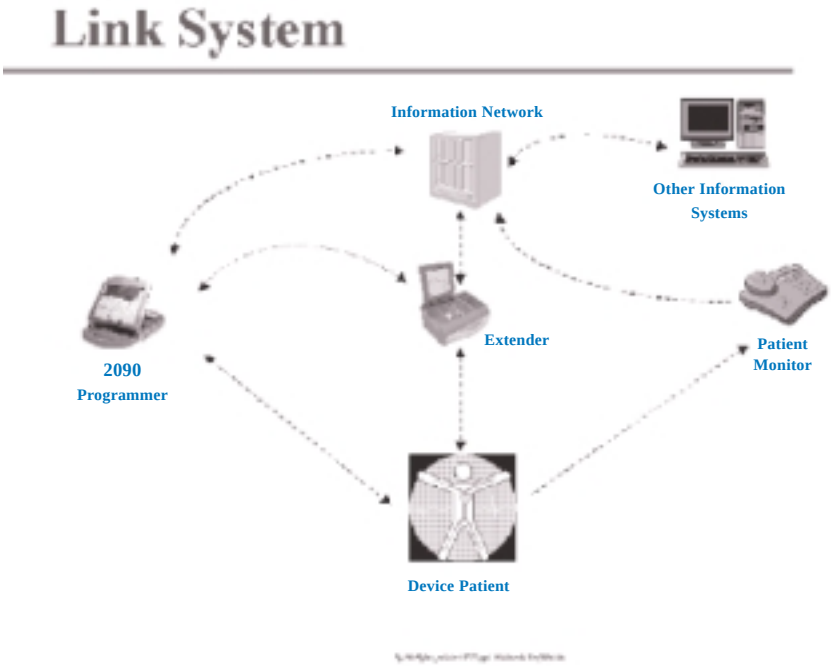

Figure 2 The Medtronic pacemaker and defibrillator monitoring system soon undergoing trials at BCH

Six hospitals in the Republic of Ireland performed 214 pacemaker follow-ups in a typical month. On average the longest distance travelled was 190 miles. In Cork over a one month period 41 patients travelled 4,264 miles to have pacemaker checks.

6. Recommendations

General Practitioners throughout Ireland would benefit from an ECG overreading service. If receiving centres were identified throughout Ireland then GPs could transmit to any centre they choose .

Tralee General Hospital would be better served with a satellite echo service from Cork University Hospital. A clinic could be set up once per week with a telelink which could be used by doctors in an emergency.

Pacemaker patients would be better served by placing remote transmitters in centres or hospitals within a 30 mile radius of their home. This would be of great benefit through the whole of Ireland, Tralee again being one of the most significant areas to benefit along with Donegal.

If equipment crashed at one centre, or if there was a staff shortage to do the clinic, the clinic could be immediately switched to another centre North or South, to enable the follow-up clinic to be done. This would prevent the cancellation of clinics.

Small remote hospitals could avail of Holter facilities using new transmission technologies such as email, with little expenditure. This would also give them access to the larger centres where the experts are.

7. Conclusions

It is often and quite rightly pointed out that accurate and fast diagnosis and treatment are not the only factors in providing competent medical care. Patients also need to feel that they are able to talk to their doctor, and that the health care professional taking care of them should know them and listen to them. As you can see with these models outlined above, the patient is in contact with local carers whom they will get to know more quickly and at the same time have immediate access to the expertise in the large centre.

These methods also reduce the distance which patients have to travel, therefore providing immense benefit to elderly and patients in ill health. They are cost effective, and provide patients with a much better service at local level.

Acknowledgements

The Hospitals which contributed to this report are as follows:

Adelaide & Meath, Tallaght: Dublin
Bons Secours Hospital: Cork
Blackrock Clinic: Dublin
Mater Private Hospital: Dublin
Sligo General Hospital: Sligo
St Vincent's Hospital: Dublin
University College Hospital: Galway
Craigavon Area Hospital: Craigavon
Altnagelvin Hospital: Londonderry
Erne Hospital: Enniskillen

Major contributor:
University Hospital Cork: Cork

References

Rissam HS, Kishore S, Srivastava S, Bhatia ML, Trehan N,
Indian Heart J 1998 Jan-Feb:50(1):55-8

Finley JP, Sharratt GP, Nanton MA, Chen RP, Bryan P, Wolstenholme J,
MacDonald C, J Telemed Telecare 1997:3(4):200-4

Gustke S, Balch DC, Rogers L, West VL, Arch Farm Med 2000 Nov-Dec; 9(10):1036

Thrall JH, Boland G, Semin Nucl Med 1998 Apr;28(2):145-57

6

A Report on the Technical Infrastructure for Classroom Videoconferencing and Related Communication

Based on the experience of schools participating in the Dissolving Boundaries through Technology in Education Project

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Preamble

The following report by Christian Harper, NUI Maynooth, summarizes lessons learned from past and current education through technology cross-border projects. The emphasis is on the technical infrastructure. The aim is "to create a sustainable cross-border learning link" based on videoconferencing and related technology.

Clearly described in this section is the equipment used and the human resources needed to tie everything together. Problems related to scaling up a videoconferencing system are noted, in particular with regard to the use of local area network hubs. The latter are needed as the school's network expands. Equipment-related problems are also noted in regard to clear access to incoming audio and video signal. The reader can get a good feeling for the quantity and level of expertise needed to set up and maintain such systems.

The contacts between schools in the Republic and in Northern Ireland were based on considerable enthusiasm. This enthusiasm of school students, teachers, and technical support staff is continuing. The experience gained in such inter-school and cross-border linkage endeavours can be used in the future above and beyond the educational system.

1. Introduction

The Dissolving Boundaries through Technology in Education Project involves 52 schools from both the primary and post-primary sectors in the Republic of Ireland and Northern Ireland. The project aims to support schools to engage in collaborative curricular projects using computer and video conferencing. In particular, the project is designed to promote:

- The integration of technology in a meaningful way into curricular work.
- Educationally valuable collaborative work done in schools.

- Cross border linkages, promoting mutual understanding.

- Sustainability of such work beyond the end of the project in June 2001.

The project is sponsored by the Department of Education and Science, Republic of Ireland (DES); the Department of Education, (Northern Ireland); eircom and Dell Computers. It is managed by the Department of Education at the National University of Ireland, Maynooth, and the University of Ulster School of Education.

2. Timescale

Planning for this project began in September 1999 with two coordinators - one for the Northern Ireland schools involved, one for the Republic of Ireland schools involved -who were appointed in January 2000. Schools were selected by February 2000 and project work began in schools in March 2000 after participating teachers met for planning conferences in Belfast and Maynooth. The hardware provided by the commercial sponsors was rolled out and installed in the period between May and September 2000. A further round of project work was planned in September for the Christmas term. Additional project work, either by continuing existing project links or forging new ones, has been ongoing currently in the term before Easter 2001.

The corporate sponsors prescribed the initial specification of the PCs provided for the project schools. Each participating school received four PCs. Windows 98 OS with Microsoft Office 2000 Premium software was installed on each.

One of the tangible outcomes of the project is to post educationally valuable, collaborative material onto web pages on the Internet. Microsoft Office Premium also includes FrontPage 2000, a web site creation and management tool. This WYSIWYG HTML editor allows teachers of all user levels to create web pages pertaining to their project and post them on the Internet.

These PCs also came with the capacity to be networked. Although networking was not part of the original package, it was proposed that the PCs should have this facility to allow networking to be added at a later date, should the opportunity arise. Evaluation from the project previous to Dissolving Boundaries, “This Island We Live On”, revealed that project work was impeded in some schools with limited access to the Internet through the bottleneck of one online machine. Further educational value could be derived from allowing multiple PCs to connect to the Internet, therefore widening student access.

3. Specification of Video Conferencing

One of two video conferencing kits was given to schools:

(i) PC conferencing
Additional hardware by way of an ISDN card was added to one of the PCs. This was connected to a PC conferencing camera with conferencing software installed on one of the PCs.

(ii) Video phone
This piece of hardware operates independently of the four PCs. The user interface is like an ordinary telephone, promoting ease of use.

Figure 1. Primary school pupils using video phone with television to communicate to their link school.

In order for the video conferencing solutions to work to full capacity, each participating school required access to a 128K ISDN line.

The delivery brief for these pieces of kit was initially to provide post primary schools with PC conferencing and primary schools with video phones. This was based on the assumption that post primary schools tend to have better technical support than teachers in the primary sector. Therefore, slightly more complex PC conferencing systems might be better supported in the post primary schools.

A Report on the Technical Infrastructure for Classroom Videoconferencing and Related Communication

At the initial cross-border collaborative training sessions in March and April 2000, both pieces of equipment were demonstrated and the opinions of the teachers involved in the project taken into account, since they would have the best knowledge of their situation regarding technical support. The result was that 19 of the 20 post primary schools opted for the PC conferencing system, while 27 of the 32 primary schools opted for the video phone. The primary teachers who requested the PC conferencing were all based in the Republic of Ireland and had some previous experience in conferencing or some technical assistance or expertise.

In addition, each school was provided with a 21" colour remote control television with AV outlets in the front panel. This allowed the image on the video phone or on the PC screen to be transmitted through the AV channel to the larger screen, therefore enabling a larger audience.

In the case of the video phones, the television was linked using a stereo audio cable consisting of four jacks that plug directly into the AV outlets of the video phone to the television.

In the case of the PC conference, a VGA to video (PAL) converter was added to the PC, enabling the image from the PC screen to be transmitted onto the television.

Figure 2. Videoconferencing using PC.

4. Internet Access

Internet access was provided on one of the four computers using a peripheral terminal adapter for the ISDN. In addition each school was provided with an Internet account on an ISP. This included an email address of the school's choice and web space for upload of web pages pertaining to collaborative project work if the school did not have an existing web site.

The project operates its own web site (www.dissolvingboundaries.org) which provides a focal point for teachers about forthcoming events, news and information. There is also a section of FAQs where any difficulties that teachers have experienced are posted and the answers, in the form of step by step solutions, are presented. This is updated on a regular basis and the teachers notified by email circular of any new pages added.

5. Networking

A networking solution was sought in Northern Ireland. Using a four port router hub and CAT 5 cabling, the four project PCs were networked in the Northern Ireland schools that required a LAN.

In the Republic of Ireland, this solution was installed into two primary schools as a tentative pilot to assess the impact of network provision for learning.

6. Location of Equipment

Location of equipment has varied from school to school. While there is no prescribed way to install this kind of equipment, there are various technical and classroom management issues arising from the equipment's location within the school environment.

Addition to an existing school LAN or computer room

In 13 schools cross border (eight primary, five post primary), the four PCs were added to an existing LAN. The project teacher then reserves the room on timetable in order to access the technology. While this provides sufficient access in many cases, there is the potential to create a bottleneck if the room is heavily used or booked by other subjects and teachers. This can cause inflexibility in the timetable which can impede project progress.

The photograph in Figure 3 shows how the computers have been integrated into one classroom as a four PC LAN in the main school computer room (which is not networked). The participating teacher is the ICT coordinator for the school, and the computer room is next door to her classroom. She has insured that there is a slot in the timetable each week for her class to participate in Dissolving Boundaries work.

Figure 3. Set up of the four PCs within a computer room in a primary school.

PCs set up in a "project room" on their own

Seven participating schools set up the PCs in rooms of their own (three primary, four post primary) with the objective that these PCs be used solely for this project work. In one case, the school chose to network these four machines. However, the three primary schools did not have an existing "computer room" and the Dissolving Boundaries "project room" has become this facility. One of these primary schools was subsequently networked by the project as part of the networking pilot. All of the rooms in question are small, restricting numbers that might access the PCs, and this can restrict the observation of video conferencing by large classes.

PCs dispersed with Internet access in project teacher's classroom

In three participating schools (two primary, one post primary) the PCs were dispersed to classrooms throughout the school as "stand alones", and the video conferencing placed in one room. In one school, the PCs were mounted onto trolleys for mobile access in the classroom. In another school, the whole computer network is on trolleys that are "parked" in the computer room. The individual project teacher books a number of these machines and they are wheeled to the teacher's classroom for use. Each room is fibre optic connected to the ISDN line for Internet access, with the possibility of having a number of computers online in the project teacher's classroom at any one time.

Machines set up in project teacher's room

In three schools (all primary), the computers and PC conference were set up in the project teacher's room. The teachers in this situation have commented on how this is beneficial to classroom organisation of the project since the technology is present for the project class at all times. The students do not need to leave the classroom to perform a video conference or to use the PCs to communicate with their link school. The project becomes "integrated" so to speak within the structure of the classroom environment.

7. Access to Web Conferencing / Email

Communication in this way was facilitated by two methods, email and web conferencing.

Each project teacher was trained to use a web conferencing site, www.nine.org.uk. NINE stands for The Northern Ireland Network for Education. All teachers and students participating in the Dissolving Boundaries through Technology in Education Conference on this site are required to register both online and through the project co-ordinators as a security measure. When registered, each individual can leave messages in their own online project folders within the Dissolving Boundaries through Technology in Education Conference. This site is constantly monitored by the project coordinators.

This has wider information and communication access than email, which is essentially one to one, whereas web conferencing allows all participants to read and respond to messages, either in their own folder or in other projects. Conferencing on NINE provides students and teachers with an opportunity to communicate and collaborate with all the participants in Dissolving Boundaries. In turn, this provides wider benefits in terms of access to information and collaborative project work being done in each school, promoting an online information community.

Use of NINE was not prescribed - teachers were given the choice to use this as their communication medium or use email. Two projects, a total of four schools, decided to use email instead of NINE. One teacher was asked why she had this preference. She essentially outlined three reasons:

- It was one less thing to learn and to contend with for herself and the children.
- The initial training with NINE was good but there were hitches with attachments.
- Email is cheaper for the school. The children can compose the e-mail off-line and then send quickly. "Have you any idea how long it takes the children to write a sentence?"

8. Videoconferencing

OFTEL number change in Northern Ireland

On 12th April 2000, all telephone numbers in Northern Ireland changed via an OFTEL directive. The old Northern Ireland code from the Republic of Ireland of 08 was replaced with 048 (this is 028 in Northern Ireland), with a series of new area codes prefixing the old five and six digit numbers. This was widely advertised in Northern Ireland but less widely advertised in the Republic of Ireland. This caused some confusion in the participating Republic of Ireland schools in terms of user error in dialling from the Republic of Ireland to Northern Ireland. This had the consequence of causing some initial connectivity problems resulting in planned conferences not taking place. The correct codes and numbers were provided to all participating teachers and this solved the problem.

Networking in Northern Ireland

The installation of a network for the four PCs in Northern Ireland caused initial connectivity problems in some of the project schools. Some participating schools were unaware that when the hub is enabled there is not enough bandwidth available to successfully connect or receive a conference call with the Republic of Ireland. The hub needs to be completely disabled to allow successful conference calling. Participating schools in Northern Ireland were made aware of this.

MSN configuration conflict

A number of video phones delivered in the Republic of Ireland were configured with MSN (Multiple Service Numbers). This meant that the ISDN number of the line the video phone was connected to was programmed in. Video telephones delivered in Northern Ireland were not configured in this way. This caused a connectivity conflict, in that Northern Ireland schools were able to make calls to the Republic of Ireland schools, but the Republic of Ireland schools were unable to make return calls. When these numbers were removed in the Republic of Ireland, the problem was resolved.

Audio

Initial observation of conferences showed that there was occasional difficulty hearing what was being said at both ends using both the PC and the video phones. In the case of the PC conference, audio is transmitted by directing audio through the sound card of the PC either by directly linking the speakers to the sound card or by making a jack to jack connection from the PC conferencing card to the sound card. A microphone in the top of the conferencing camera picks up sound. This can be further extended by a telephone handset that is plugged into the PC conferencing card.

In the video phone, the microphone is built into the unit with a hands free option. The user can also use the handset.

Audio quality tends to improve when the handset option is used in both cases. This restricts the management of the conference to handing the phone around the group. The student presenting anything visually at the conference is restricted to using one hand if a visual demonstration is required (for example, the pupil in Figure 1 is showing a picture). Therefore each school has been provided with a microphone mixer to allow the attachment of four microphones to the conference. Although these microphones can be hand held, there is a stand option so that the pupil's hands are free for demonstration if required.

9. Conclusions

Evaluation is currently ongoing into this project and it is hoped that results regarding the educational value of video conferencing projects in schools participating in Dissolving Boundaries through Technology in Education will be available by early Summer 2001. There has been one tentative evaluation already in Summer 2000 resulting in an Interim Report published in August of that year. This was funded and co-written by colleagues in Northern Ireland who are part of InTENT (Infusing Teacher Education with new Technologies).

One of the fundamental aims of Dissolving Boundaries through Technology in Education was to create a sustainable cross border learning link using the technology provided. One of the inherent risks of a project involving short term provision of support to schools is that the activity of the project could end after this period of support. Through training, collaborative workshops and linking teachers together both physically and virtually, the intention is to minimise this effect through measures designed to encourage sustainability.

Initial findings suggest that the introduction of video conferencing technology in the classroom is, to some extent, challenging the traditional learning environment. In one Republic of Ireland school, video conferencing is very much "student directed" - the teacher becomes a passive facilitator during a video conference with the school's Northern Irish counterpart, cutting against the grain of the teacher's usual formal controlling role. The pupils in this school have become comfortable with the technology (they have participated in a conferencing project previous to Dissolving Boundaries) and are familiar with the students they are seeing and learning from at the other end of the link. The students regularly post work and pictures pertaining to their project on their respective school web pages.

In most of the other schools, the video conference so far is mainly used in three ways:

- as a performance medium,
- as a demonstration medium,
- as a meeting place for "directed" chat (prepared questions etc).

It is anticipated that given more time the function of the video conference in the classroom will take on a wider role of a more thought-provoking nature.

One tentative conclusion the interim report reached was that the project was perceived very positively by the participating teachers:

- Most teachers reported their perception of the project as educationally valuable.
- Most were also prepared to continue, and to take on additional tasks in the future.
- They also reported student enthusiasm for the project [1].

The introduction of this technology is possibly one key to promoting further mutual understanding between cultures in Ireland. Again this was one of the key aims of Dissolving Boundaries through Technology in Education. As one student in the Republic of Ireland commented in the evaluation for the interim report:

"They are people, Protestant and Catholic, they are all the same". [2]

It is important however, to contribute some of this success not only to the technology, but to the teachers and students who use the technology successfully as a learning tool.

References

[1] Dissolving Boundaries thorough Technology in Education Interim Report, August 2000 (InTENT), from Part 3 "Sustainability of the project" - A. Mulkeen and C. Harper - Page 38.

[2] Dissolving Boundaries thorough Technology in Education Interim Report, August 2000 (InTENT), from Part 2 "Dissolving Boundaries: the social dimension" - J. Collins.

7 Inexpensive Videoconferencing and Video Publishing

Preamble

The technologies which are available right now, and inexpensively - and not used widely as they ought to be - are examined in this **two-part section.**

The possibilities for individual, or small group, communication and collaborative work based on software products such as Microsoft Netmeeting are very advantageous indeed.

The opportunities for digital recording and relaying of workshops and other collective and social events, for educational or other purposes, are similarly feasible with little investment.

These technologies are on the threshold of providing take-off potential for technologies such as videoconferencing which have been around and little used for a very long time.

Videoconferencing is only one technology among the range of collaborative work tools which are on offer. Collaborative work tools include chat environments, document sharing, and cross-network whiteboards. Such tools, unlike video, may have a big advantage in that they do not require transmission of large quantities of data. They may thus place less strain on clogged network lines than video.

Low Cost Videoconferencing between the US, Belfast and Dundalk

7
part 1

MOHSEN FARID

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Summary

In this section we discuss audio and video conferencing experiments that took place between three sites: Mansfield Center, Connecticut, in the US, Belfast in Northern Ireland and Dundalk in the Republic of Ireland. The objectives of the experiments are to demonstrate the possibility of establishing audio and video communication over low speed off-the-shelf (OTS) products, and to assess the performance and reliability of the application environment. In these experiments, we focus our attention on the PC Microsoft Windows environment.

1. Introduction

The experimental configurations are:

1. A 200 MHz Pentium (generic) computer with an adequate hard drive space, dialup Internet, half duplex sound card, head speakers and microphone.

2. A 300 MHz Pentium (Toshiba) laptop computer with adequate hard drive, built-in modem, PCMCIA Ethernet card, built-in full duplex sound card, a headset, a microphone and an Intel 640x480 webcam.

3. A 700 MHz Pentium (Sony PCG-F680) laptop computer with 192 MB RAM, 20 GB hard drive, built-in sound card, headset and microphone and an Intel 640x480 webcam.

2. Assumptions

Certain assumptions were necessary to test the functionality, performance and framework reliability. The assumptions stem from what we think low-cost audio and videoconferencing ought to be and what is discussed both in the literature and Web. While these assumptions are not necessarily conclusive, one might think they provide adequate description of a low-cost conferencing system.

An audio and video conferencing system needs to:

1. Provide text-based chat and instant messaging.

2. Provide the ability to document user interaction sessions (both textually and graphically) for later retrieval.

3. Provide a real-time whiteboard where interacting can use draw, write and other idea-illustrating tools.

4. Provide the ability to integrate with office tools such as word processor, spreadsheet, etc. It would be of great benefit that such an environment be capable of interfacing with Microsoft Office 97 or Microsoft Office 2000. The choice of these two packages is solely based on the fact they are widely used and have been accepted as a *de facto* industry standard.

5. Provide "adequate" audio and video support for communication. There is no doubt that a rather elaborate and rigorous measure of adequacy could be devised. We assume that adequacy is measured primarily by subjective "user acceptability".

6. Allow users not only on an intranet to interact but also web users separated by distances for which long distance phone charges are applicable.

7. Be "freely" available everywhere. By freely, we mean that the solution is readily available on the web, easily downloadable and easily installable. We also mean that it costs little or nothing.

8. Be an open and extensible platform for real-time communications offering audio, video conferencing functionality. It should allow both programmers and web authors to easily "add" or "modify" functionality to customize it to suit their work environment. Such programming efforts should be limited in scope, time and effort.

9. Additionally, it would be desirable for such an environment to interface with LDAP (Lightweight Directory Access Protocol) type servers so that users on the internet and an intranet can easily be located.

3. Software Product Survey

Currently, the market has a number of products that satisfy some or all of the requirements that we have set forth earlier. For the purpose of this report, we have used software products that are commonly known and have been around long enough to show maturity and resilience to problems.

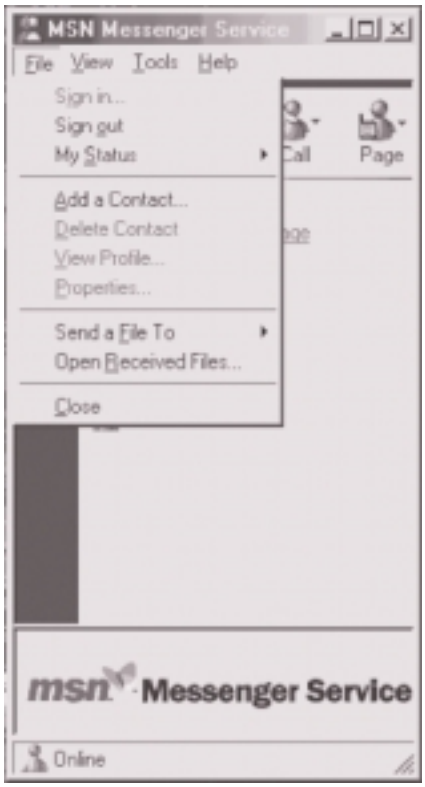
(i) Microsoft Netmeeting and MSN Messenger (http://www.microsoft.com/netmeeting, http://www.msn.com).

MSN Messenger provides an audio conferencing and text mode chat. The text chat is as good as anything on the market today. It is definitely in the same league as ICQ (http://www.icq.com) or Yahoo Messenger (http://messenger.yahoo.com). It performs very well over dialup connections. The audio conferencing is done through Voice Over IP connections (VOIP) which utilizes a third party service provider (e.g. Net2Phone - http://www.net2phone.com). With this service audio quality is reasonable most of the time, but it has a tendency to stall at unexpected periods of time indicating line congestion especially for international calling. Understandably, calls within and into the US are charge free. Calling into other countries from the US or from one country to another is not free. (Average cost per minute for an international call is $0.037 - $0.047)

Figure 1. Microsoft MSN main window.

Figure 1 shows the simple design of the Microsoft MSN Messenger. The screen shows who among your contacts is currently on-line, and who is not, and the status of each. It shows simple icons depicting how to add more contacts, send messages and mail, make phone calls or even send text messages to pagers.

Figure 2. MSN file menu.



In Figure 2, one sees logging-in and logging-out functionality and the ability to save information on permanent storage.

Figure 3. The tools menu.

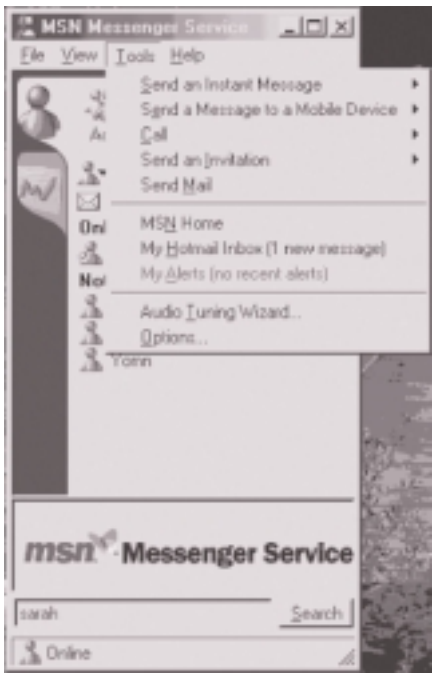


Figure 3 shows menus for sending instant messages, sending message to pagers, or making a PC-to-phone call.

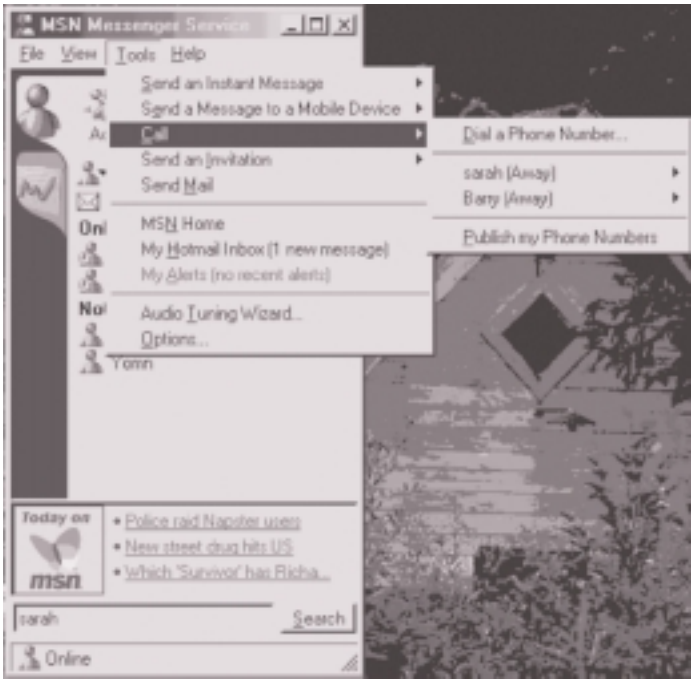


Figure 4. Calls can be made to people from an address book or just on the fly.

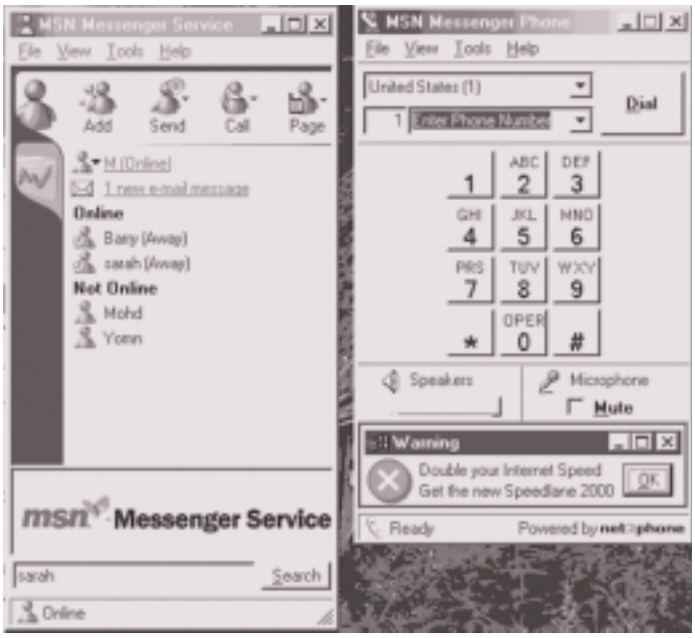


Figure 5. An emulated phone dialpad, intuitive and accessible with use of the mouse or keyboard.

Figures 4 and 5 show metaphors of the phonebook and a phone dial pad. Note that support of international dialling is available, but currently this service needs to be paid for when calling from the US to other countries or when making calls between countries other than the US.

MSN Messenger enables conferencing by invoking Microsoft Netmeeting (Figure 6).

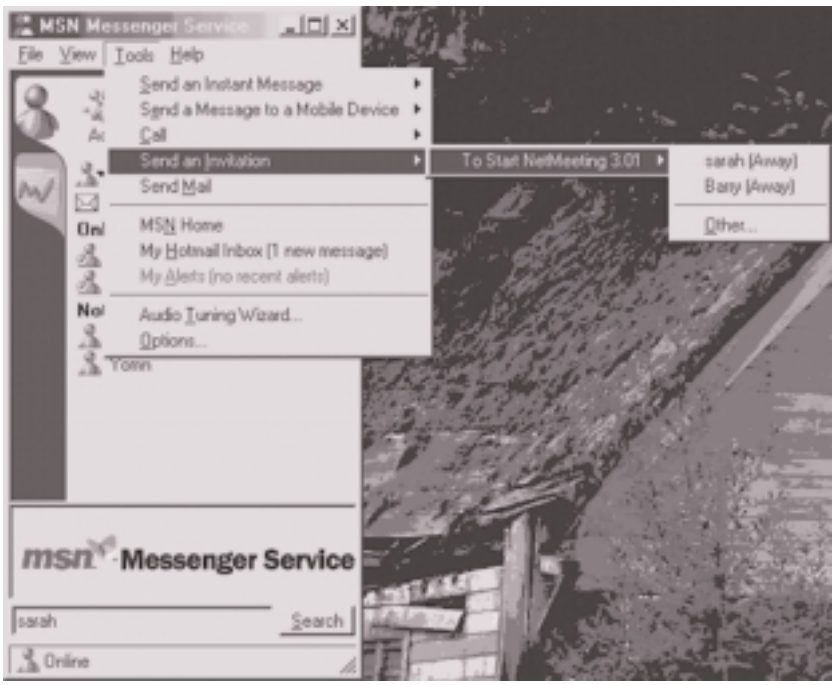


Figure 6. Netmeeting can easily be invoked from MSN Messenger.

Netmeeting is classified as groupware software. It provides a robust whiteboard interface and application sharing.

Through the MSN both PC-PC and PC-phone communication is possible.

(ii) Yahoo Messenger
It provides basic text based chat and messaging. It also allows for voice mail.

(iii) Dialpad
This is a fully fledged PC-phone (Voice over IP, VOIP) telephone. Calling from a site to another within the U.S. or calling from sites outside the U.S. into the U.S. are free. Calling from the U.S. to another country or between any two countries is not free.

(iv) Hottelephone
This is a PC-phone telephony application.

In a nutshell, we found Microsoft Netmeeting to satisfy the largest subset out of all previously stated requirements. While it may not be such a high end dedicated piece of software, it has been successfully used by many users across the globe.

4. Experiments within the US

In December 2000, PC-PC and phone-phone connections were set up between a colleague at the Department of Economics, University of Connecticut, and myself. The setups were situated in our own respective houses. The setups were a PC with a modem and a webcam at the colleague's end and a similar setup at my end. In addition to the regular voice line, I had another telephone line dedicated to data communication. I lived in a rural area, and my communication rate would hardly have exceeded 26,400 baud most of the time.

The experiment was set up so that the colleague would initiate a PC MSN Messenger and Netmeeting sessions into my PC using Netmeeting and the other voice telephone using MSN. The MSN session is a PC-phone connection whereby a call is initiated from the PC using a software simulated dialpad. The dialpad would be used to "dial" the phone of the other party. A ring tone is heard on the PC speaker, similar to the ring tone that is heard on regular phones. When the other party picks up the headset, a phone call is established.

While both MSN Messenger and Netmeeting were running (Messenger to phone and Netmeeting to PC), audio communication had a latency of 1-2 seconds, with Messenger to PC having a little better voice quality than the simultaneous Netmeeting-Netmeeting session. When video was turned on, video images would update at longer intervals, taking 10 - 15 seconds per frame. (Video refresh rates sometimes improve drastically, allowing for subsecond rates.)

5. Discussion and Conclusions

The focus of this report is to look at possibilities of establishing low cost teleconferencing solutions and to understand and assess the quality of service and cost-performance ratio.

In general, traditional teleconferencing is a technology that provides virtual round table conferencing where geographically remote parties can talk with each other as if they were located in the same meeting room. The technology is based on a high speed link (such as ISDN) that allows both audio and video communication.

PC-based solutions (such as MSN Messenger and Netmeeting) seem to offer a robust platform upon which not only "classical" teleconferencing is possible, but also a platform which is capable of completely sharing the work environment of documents, files, internet based applications, spreadsheets, audio and video communications.

Low Cost Videoconferencing between the US, Belfast and Dundalk

One must bear in mind that the work throughput is proportional to the bandwidth of the communication speed. One should observe that as large corporations are moving into fibre optic speeds, small businesses are climbing up to full T1 (approximately 1.5 Mbit per second). Likewise home based users often avail of higher than dialup speeds. In the US cable speeds (up to 900 kb/s), xDSL which uses standard telephone wires and provides bandwidths of 512 kbit to 6Mbit per second, and ISDN, thought much more expensive and tariffed, providing speeds in the range of 128 - 512 kbit per second, are becoming commonplace.

In the Republic of Ireland, ISDN is a good possibility for small and home-based businesses. During my stay in bed and breakfast accommodation in the Republic, I was asked several times by owners about high speed alternatives to dialup to offer to guests, especially business people who need to be in constant contact with their respective companies and business associates.

For the mobile communication arena, while mobile telephones provide a slow 9600 bit per second speed, such speed is adequate for text type communications. It is unrealistic and unimaginable to assume that mobile communication would stay at such slow speed. As the mobile speeds improve, there will be application opportunities to enhance the quality of life (e.g. through telemedicine), quality of learning and educational availability, improved business communications and everything in between.

Since arriving in Ireland in January 2001, I have been using a web based phone via MSN Messenger, MS Netmeeting and Dialpad to communicate with my family in the US several times a week, and the best part of it is that it is free.

An indicative summary of connectivity options and prices is shown in the following table. It takes account of regular modem dialup; dedicated line; ISDN; T1, typical for large companies, universities and so on; TV cable; DSL cable connection; and mobile phone access.

Low Cost Videoconferencing between the US, Belfast and Dundalk

Service	Speed range	H/w price in Euros	Monthly service charge in Euros
Dialup	56 Kbps	30 - 200	10 - 20
Dedicated Asynchronous	56 Kbps Async	1000 - 1500	200 - 500
ISDN	128 - 512 Kbps	300 - 500	tariffed on per min. basis
T1	128 Kbps - 1.6 Mbps	1500 - 3000	1000 - 2000
Cable	128 - 900 Kbps	150 - 300	30 - 40
Digital Subscriber Line, DSL	384 Kbps - 6 Mbps	150 - 300	30 - 200
Mobile	9.6 Kbps	100 - 200	tariffed on per min. basis

In summary, the implications of connectivity options for personal or small-group cross-network collaborative work based on audio and video include the following:

- The usual 56k baud (bits/second) modem, which offers less throughput in practice. Audio is good; there may be some latency; trans-Atlantic links may be routed via satellite - as they sometimes are with a regular phone connection - resulting in added latency; video can be frustrating at times; and all told what one gets is truly outstanding if one is paying nothing, and is very acceptable if there is a small price-tag.
- A dedicated line, 56k baud synchronous, has high setup charges, and a monthly charge, but can be otherwise without charge. Performance is better than with regular modem connection.
- ISDN has low setup charges, but subsequently charges on an as-used basis. Service is substantially better than modem connection to a regular telephone line or a dedicated line.

In this report we have discussed connectivity from either part of Ireland to the US, and vice versa. What of connectivity over the Internet between the two parts of Ireland? The connection is established on the basis of an IP (Internet Protocol) address. A computer on a local network necessarily has such a numeric address. A computer with a modem connection has a dynamic (i.e. on the fly, for the duration of the session) address established. Therefore the basis exists for telephony over Internet and the other possibilities described in this section.

The second issue of importance is to be registered with a VOIP (voice over IP) service provider. Such service providers may charge the end user. Subject to such a charge, the user has free use of voice and other services subsequently. We are not aware of any VOIP service providers trading in communication across the Irish border. The way such VOIP service providers work is that they purchase, say, 10 million telephone connection minutes at bulk discount rates from a telecoms operator. They then sell this time on to the customer, who may well be coming online onto the telephone network, not with their own voice, but instead with their voice chanelled and digitized through their computer.

Low Cost Videoconferencing and Video Publishing - How and at What Cost?

7
part 2

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Summary

We look at prices, and ease of deploying, over-the-counter webcams. We also look at what is needed for putting a seminar or other event on video. On the latter, we stress the importance of streaming video.

Explanations

Partner 1 on the left is using a Philips Vesta Pro (seen on the workstation in the right hand image), running off a Sony Vaio notebook, and uploading images at 10 second intervals by ftp over a 56k b/s modem link, using Compuserve as ISP. Image management is provided by Webcam32.

Partner 2 on the right is using a Connectix Quickcam running off a Siemens desktop PC, and uploading images at 10 second intervals over a LAN connection. Image management is provided by Ispy.

Both cameras are, of course in the same office, as shown. The time settings taken from the PCs have been set up wrongly. The image sizes are typically about 30 kByte JPEGs. A quick calculation shows that each such image takes about 25 seconds to upload, if using a mobile telephone 9600 b/s modem; over 4 seconds to upload if using a standard 56 kb/s modem (terrestrial telephone) connection; and nearly immediate upload with a LAN connection.

Webcams such as Philips Vesta Pro and Connectix Quickcam are available for about £70. They allow for capture of still images or image sequences. Of importance is how they will be connected to one's PC: using the printer (serial, RS232) port; using the USB connection; or even using a PC card (formerly known as a PCMCIA card). An example of the latter is a camera from Winnov (www.winov.com and www.winov.de), the Videum, costing about £350. A camera which uses a PC card may be ideal for a notebook PC (but note that only one PC card slot is available on some PCs - for example, on some Sony Vaios - and this precludes simultaneous use of a CD reader or LAN connectivity).
Software to enable use of the camera may be supplied with one's

purchase of the camera. This is the case for the Videum discussed above. Free software is available in Microsoft's Netmeeting product. CUSeeMe (www.cuseeme.com) sells for $50 and upward, and supports Macintosh. A package called Ispy (www.ispy.nl) is now supported by Surveyor Corp. under the name Webcam32 at the Ispy web address, and sells for about $25. Functionality supported by these packages includes refreshed images uploaded by ftp or other technologies (server push, image pull). As exemplified in the figure at the start of this section, frequently refreshed images is one option for upload over modem. Another is to stream the video and, when present, audio.

Streaming is of crucial importance for video distribution on the Internet. Compression is part of any streaming format. Without compression, we collected video in AVI format from a carcam (a camera taped to the dashboard, with a USB link to a notebook PC strapped in the passenger seat), and a car ride of just over four minutes consumed over 1 GB of storage space. Streaming has a major additional advantage: it is played as soon as a sufficient bufferful of data becomes available. Non-streaming video requires download of a complete file before display is possible. Imagine downloading a 1 GB file using a modem!

Cranmore Park, Belfast, eastbound, August 2000.

Low Cost Videoconferencing and Video Publishing - How and at What Cost?

Malone Road, Belfast, northbound. An August Sunday morning, 2000.

Setting up a streaming video presentation requires, firstly, a decision on whether content is to be streamed live or made available after the event. A professional quality video camera should be used at all events. Analog tape has the great advantage of being able effortlessly and cheaply to store hours of data. This is digitized using, e.g. a Matrox digitizing card which is installed in a PC (cost about $300). If content is streamed live, then Microsoft's Windows Media server is available free. Files with format .asf are produced. (Other major players: RealVideo, Quicktime.) Equally feasible is to produce streaming video (and, it goes without saying, audio) after the event. This could be of benefit for later availability for classroom use, or at a later time for conference participants.

Examples of where we have streamed content live, or made content available following the event, are as follows. (The work of Mr Alan Soutar, Audio-Visual Services, QUB, and Dr Ricky Rankin, Computer Services, QUB, is acknowledged.)

(1) Queen's University Graduation Ceremonies:
http://www.broadcaster.qub.ac.uk/graduation (Streamed live, and archived.)

(2) IMVIP 2000 - Irish Machine Vision and Image Processing Conference, August/ September 2000, Queen's University Belfast:
http://www.qub.ac.uk/ivs/imvip2000
(Streamed live, and selected presentations archived.)

Low Cost Videoconferencing and Video Publishing - How and at What Cost?

Participants at IMVIP 2000 showing Mr Alan Collins, Computer Services, QUB, at the back right of the room, sitting in front of a PC which was streaming live digitized video, captured with the camera on a tripod immediately to his right.

Two points to note: firstly, audio quality must be good at the point of video/audio caputre. Secondly, the choice between having the camera aimed at the speaker or at the materials the speaker is presenting (e.g. a Powerpoint presentation) points to an inherent difficulty in use of one camera. It may be possible to pan between these, but the presentation material will usually not be of best resolution. This may lead to the conclusion that presentation materials should be made available in addition to streaming video of the event. Software products are available to support this.

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